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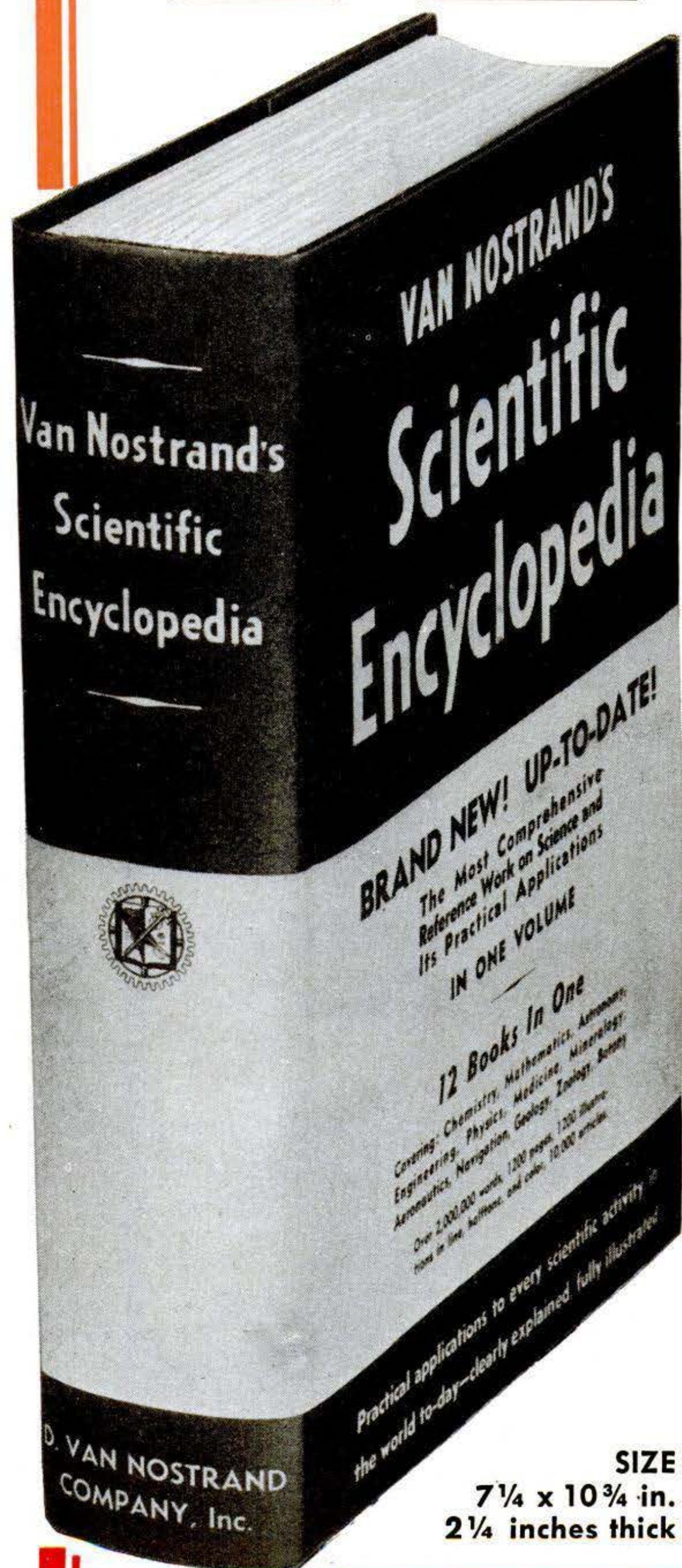
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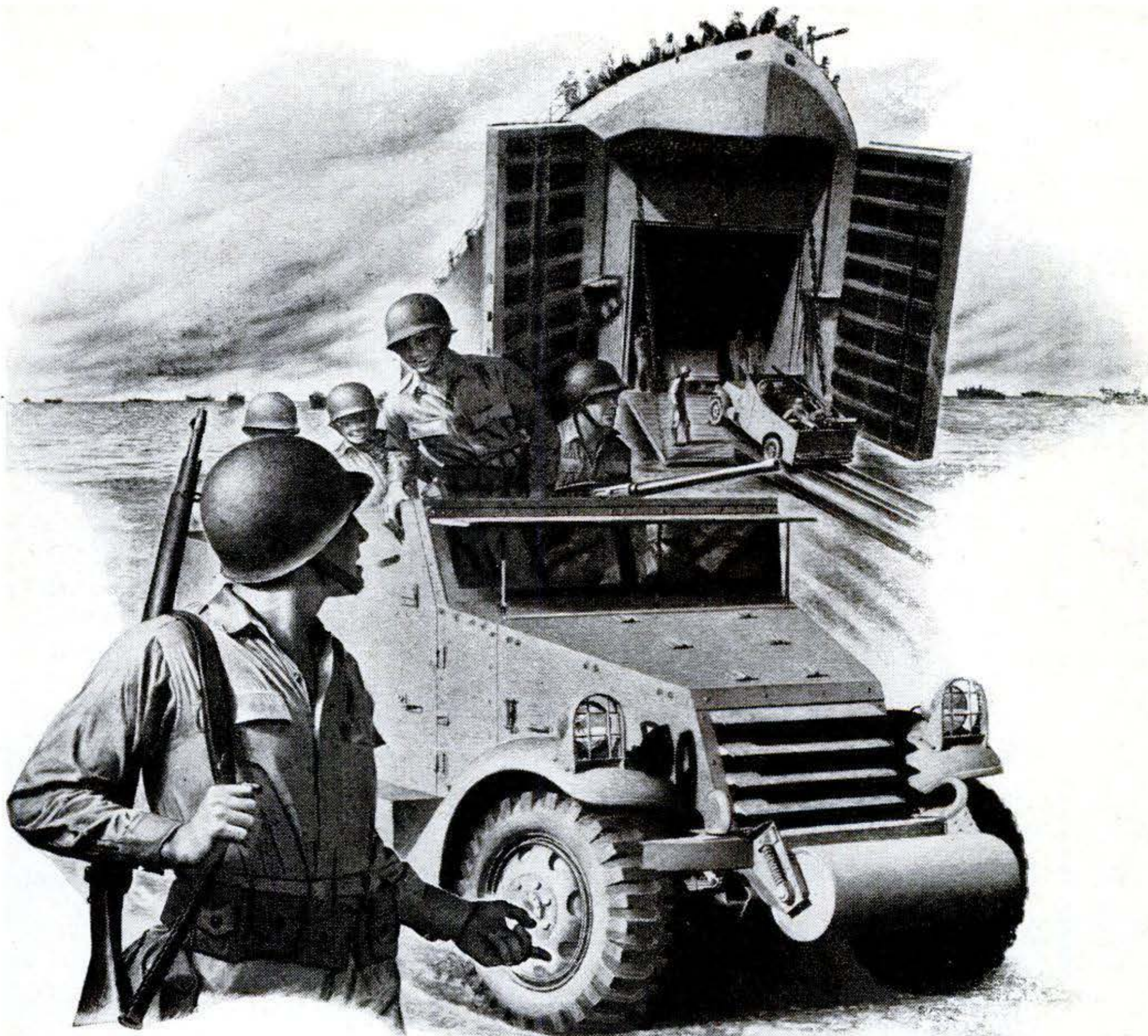
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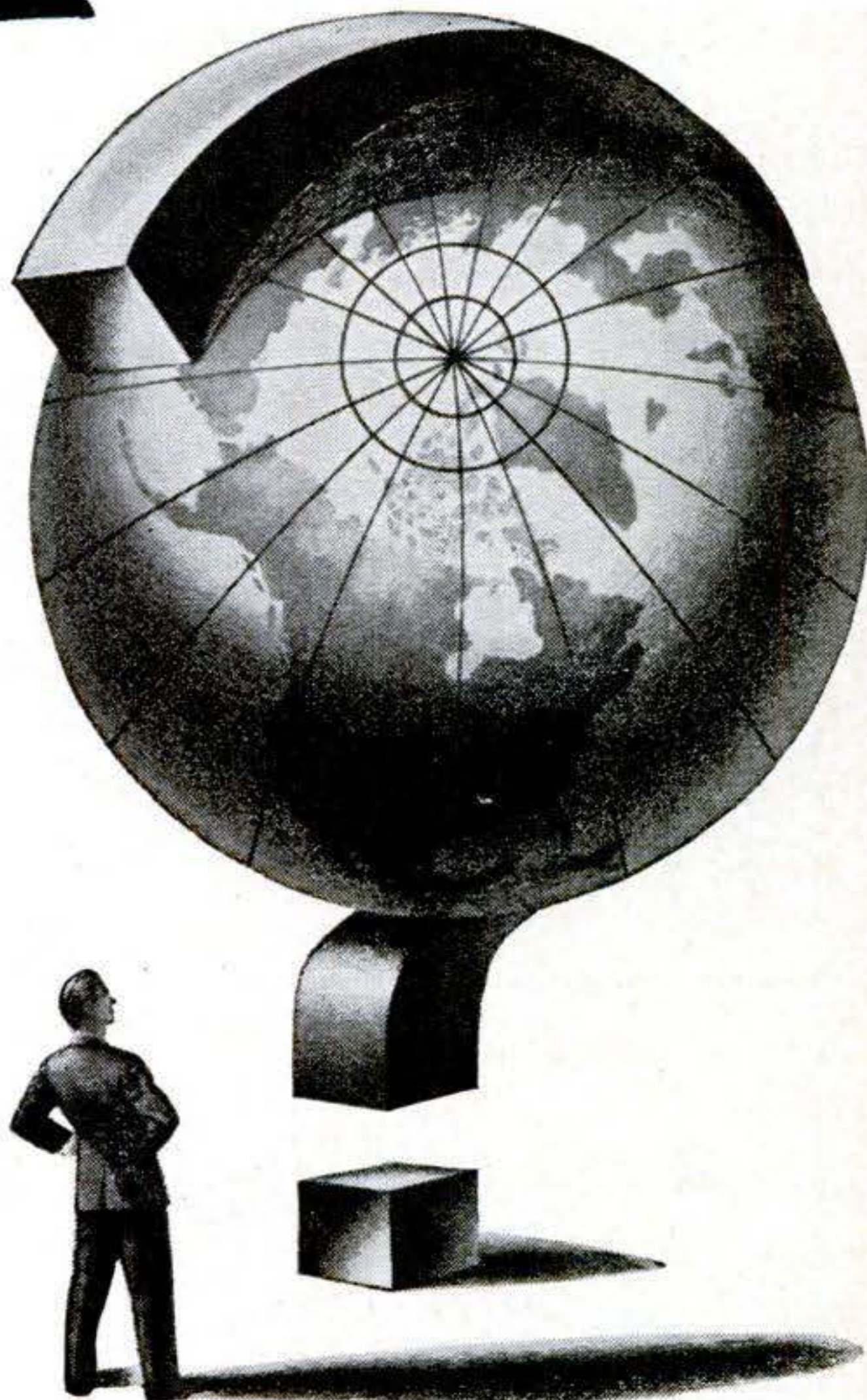
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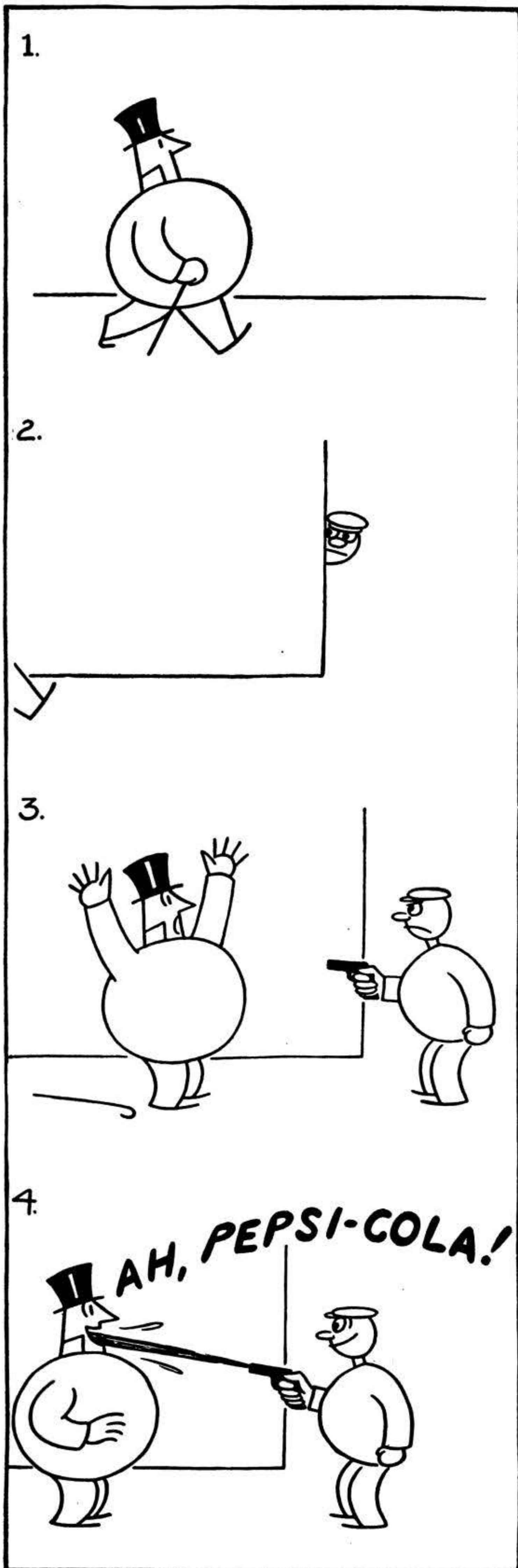
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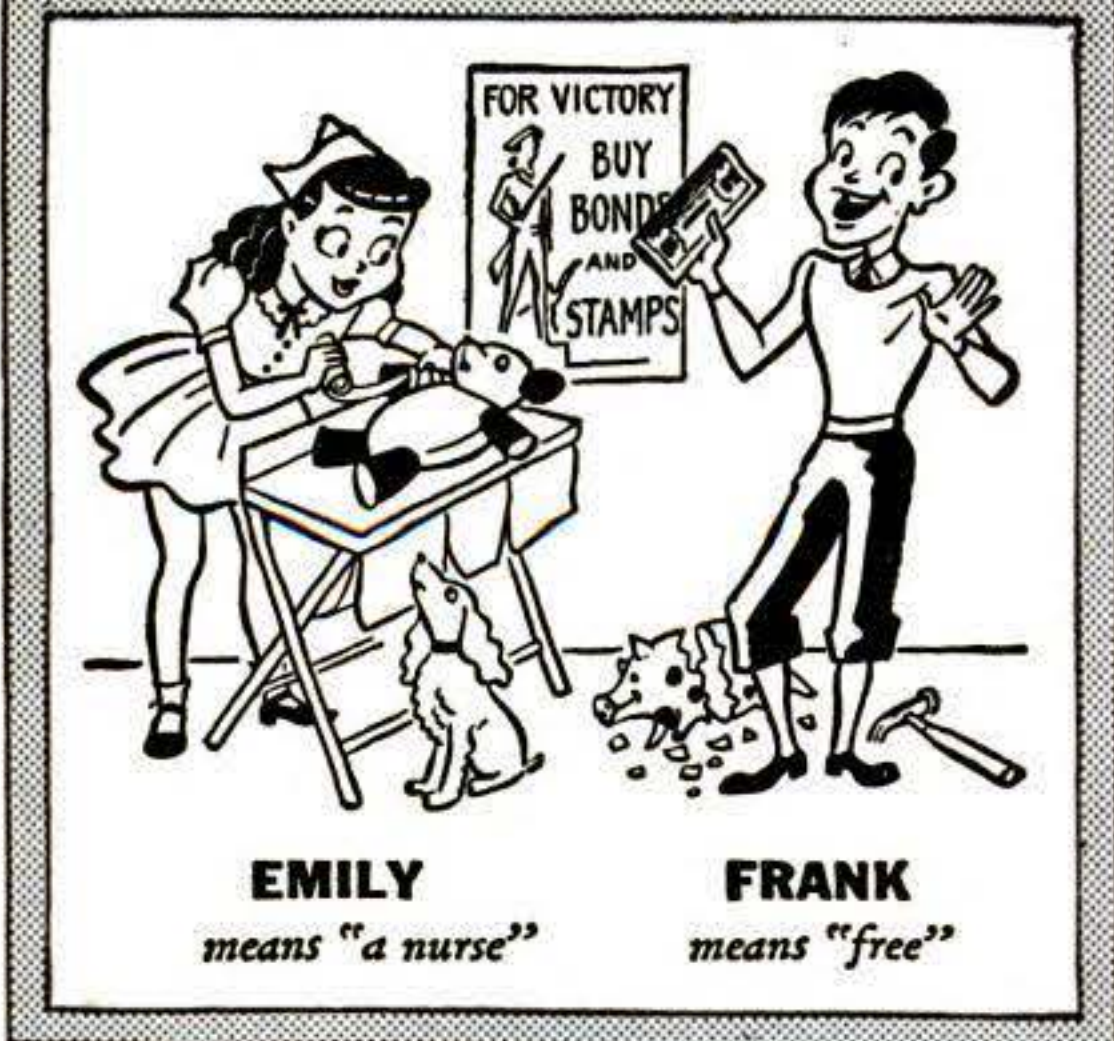
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"Superhet" Circuits work, gives hints on Receiver Servicing, Locating Defects, etc. 31 illustrations. And with this Lesson I'll send my 64-page illustrated book, "Win Rich Rewards in Radio." It describes many fascinating jobs Radio offers, explains how N.R.I. trains you at home for good pay in Radio. Get both FREE by mailing Coupon!



RADIO SERVICING (illustration above) pays Technicians good money, spare or full time. **RADIO OPERATORS** (picture at right) find interesting work in U. S. Broadcasting and other types of Stations.



Extra Pay in Army, Navy, Too

Men likely to go into military service, soldiers, sailors, marines, should mail the coupon now! Learning Radio helps



men get extra rank, prestige, more interesting duties, MUCH HIGHER PAY. Also prepares for good Radio jobs after service ends. Over 1,700 service men now enrolled.

A TESTED WAY TO

LESSON FREE

at Home in Spare Time to

TECHNICIAN



There is a Shortage of Radio Technicians. Many Good Jobs are Open!

There's a big shortage today of capable Radio Technicians and Operators. Fixing Radios pays better now than ever before. With new Radios out of production, fixing old sets, which were formerly traded in, adds greatly to the normal number of servicing jobs.

Broadcasting Stations, Aviation, and Police Radio, and other Radio branches are scrambling for Operators and Technicians. Radio Manufacturers, now working on Government orders for Radio equipment, employ trained men. The Government, too, needs hundreds of competent civilian and enlisted Radio men and women. You may never see a time again when it will be so easy to get started in this fascinating field.

Be Ready to Cash in on Jobs Coming in Television, Electronics

Think of the NEW jobs that Television, Frequency Modulation, Electronics, and other Radio developments will open after the war! You have a real opportunity. I will train you to be ready to cash in when Victory releases the amazing wartime Radio developments for peacetime uses!

Many Beginners Soon Make \$5, \$10 a Week EXTRA in Spare Time

Right now, probably in your neighborhood, there's room for more spare and full time Radio Technicians. Many N.R.I. Students make \$5, \$10 a week EXTRA money fixing Radios in spare time while learning. I send EXTRA MONEY JOB SHEETS that tell how to do it!

My "50-50 Method"—half building and testing real Radio Circuits, half learning from easy-to-grasp, illustrated lessons—is a tested, proven way to learn Radio at home in spare time. Think how much practical experience you'll get by building the "Superhet" and Measuring Instrument illustrated at right—by conducting 60 sets of experiments on these and other Circuits you build with parts I supply! Within a few months you can be ready to run your own Spare Time Shop, fix the Radios of your friends and neighbors—get paid while learning!

START NOW Toward Radio's Rich Rewards!

MAIL THE COUPON. I'll send you the FREE Lesson and my valuable, 64-page, illustrated book. They're packed with facts about Radio. You'll see snapshots and letters from men I trained, so you can know what N.R.I. did for others. You'll read a description of my Course—"50-50 Method"—6 Experimental Kits—Extra Money Job Sheets. You'll have my free Lesson to keep. And you'll see many fascinating jobs Radio offers and how YOU can train at home. No obligation—no salesman will call. If you want to JUMP YOUR PAY—Mail Coupon in an envelope or pasted on penny postcard! J. E. SMITH, President, Dept. 4BP3, National Radio Institute, Washington 9, D. C.

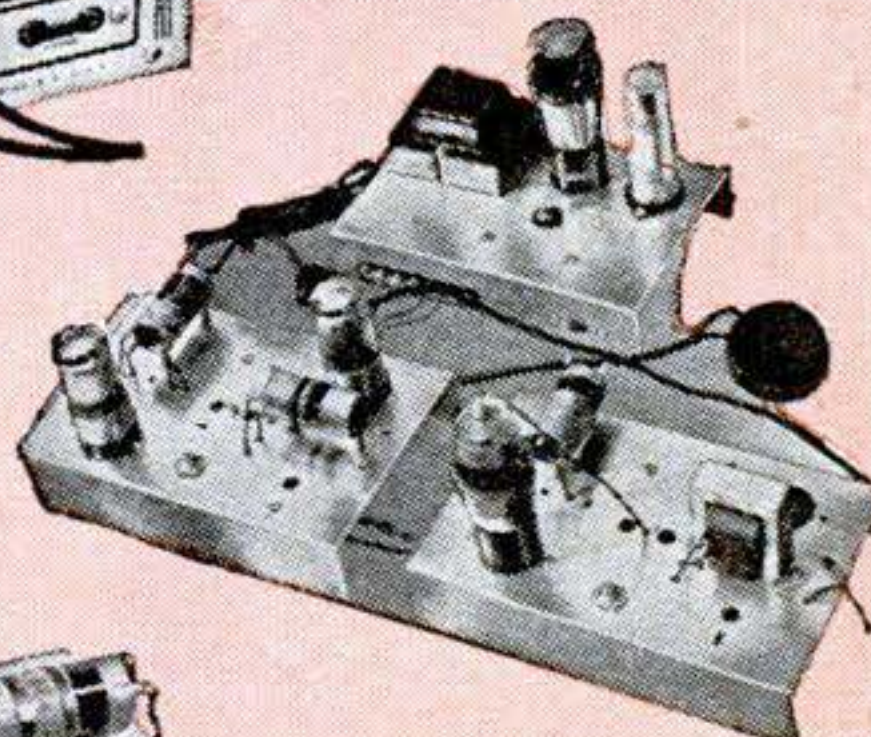
TRAINING MEN FOR
VITAL RADIO JOBS

GOOD PAY

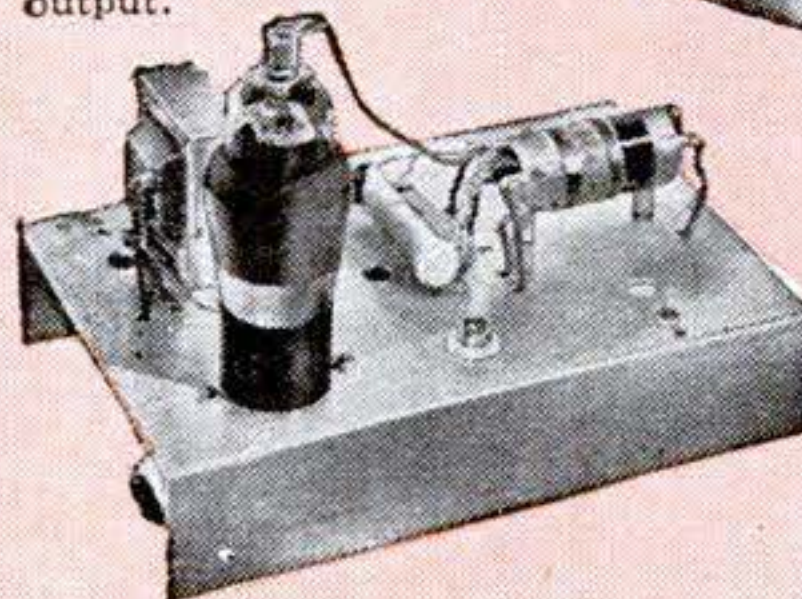
You Build These and Other Radio Circuits with 6 Big Kits I Send



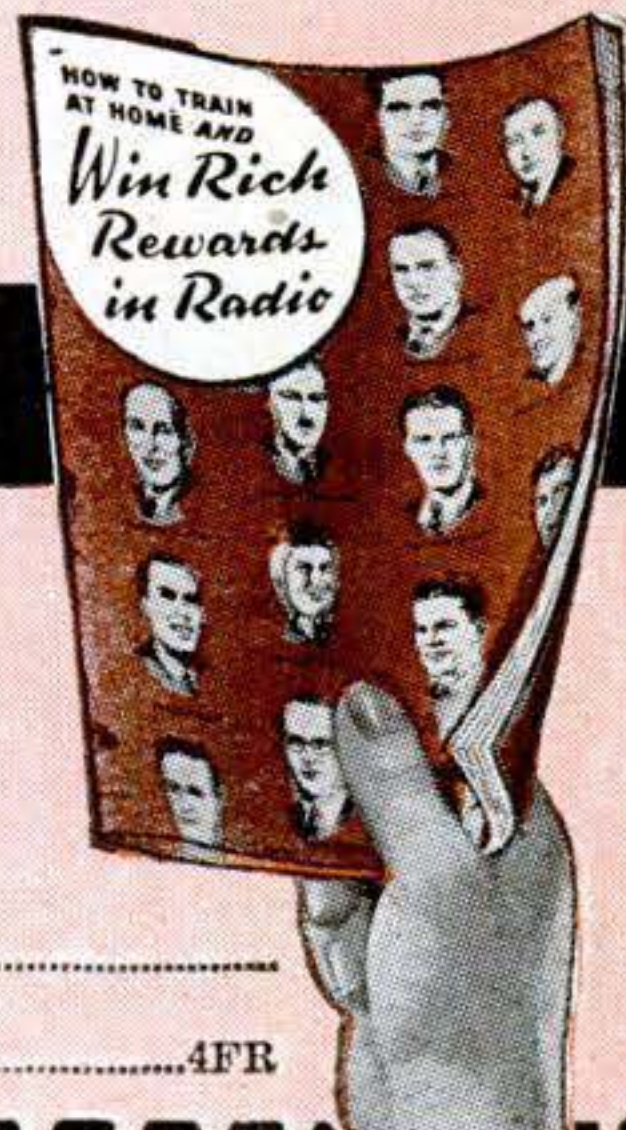
MEASUREMENT INSTRUMENT (above) you build early in Course. Use it in practical Radio work to make EXTRA money. Vacuum tube multimeter, measures A.C., D.C. and R.F. volts, D. C. currents, resistance, receiver output.



SUPERHETERODYNE CIRCUIT (above) Pre-selector, oscillator-mixer-first detector, i.f. stage, diode-detector-a.v.c. stage, audio stage. Bring in local and distant stations on this circuit you build yourself.



A.M. SIGNAL-GENERATOR (above) Build it yourself! Provides amplitude-modulated signals for test and experimental purposes. Gives valuable practice!



GOOD FOR BOTH 64 PAGE BOOK SAMPLE LESSON FREE

Mr. J. E. Smith, President, Dept. 4BP3
NATIONAL RADIO INSTITUTE, Washington 9, D. C.

Mail me FREE, without obligation, your Sample Lesson and 64-page book, "Win Rich Rewards in Radio." (No salesman will call. Please write plainly.)

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Address

City..... State..... 4FR

Listening Post!



ALEX. E. GORDON, Indianapolis, Ind.—legislative representative of the Brotherhood of Locomotive Firemen and Enginemen—brings good news to hundreds of mothers of missing servicemen, through his hobby and his faithful 16-tube, 1940 model

MIDWEST RADIO



**BUY
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BONDS**

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TIME CHART
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An attractive 4-color calendar with International Time Calculator will be sent **FREE** on your request if accompanied by 10c in stamps or coin for which we will send you a War Savings Stamp.



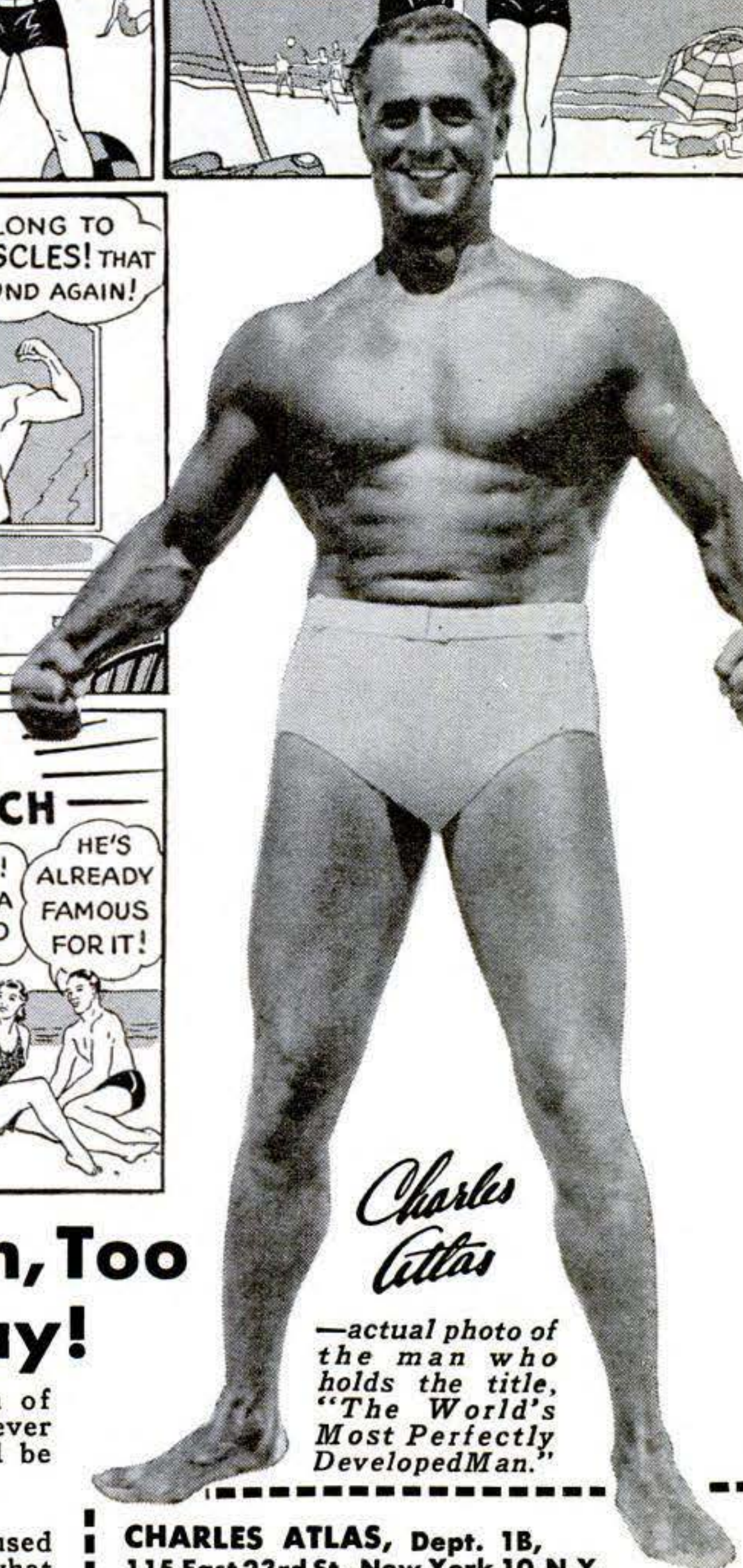
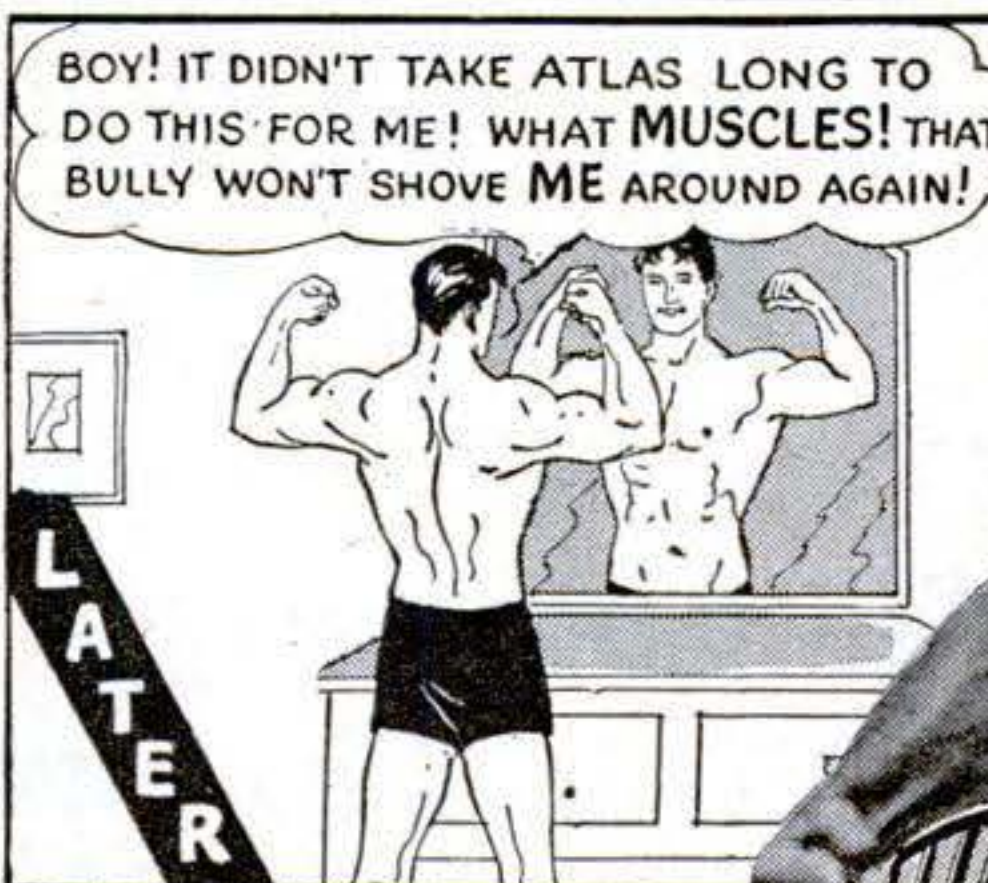
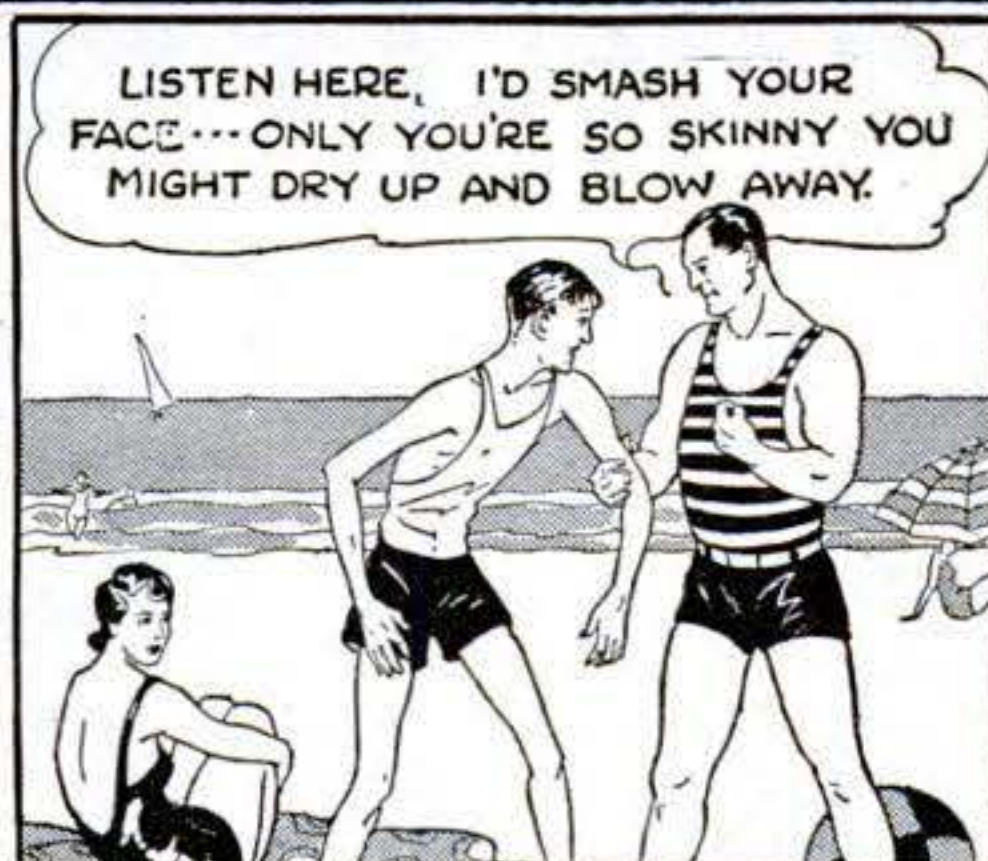
ALWAYS a short-wave radio enthusiast, Alex. E. Gordon has spent many a night listening over his 16-tube Midwest Radio to foreign broadcasts. Several months ago he noticed that the Nazis, along with their propaganda, were mentioning the names of a few American prisoners each night. Mr. Gordon began to jot down the names and sent postcards to the parents of the men named. The response to these cards was so instantaneous and gratifying that Mr. Gordon induced others to join with him in a Short Wave Listeners Club—each member of which is allotted a definite time at his listening post.

Mr. Gordon feels that he is amply repaid for his trouble by such grateful expressions of appreciation he has received: "It is a patriotic service for which I cannot thank you enough" . . . "God bless you for your kindness" . . . and other similar statements received by this Midwest Radio owner.

Just another case where a Midwest Radio, famous for its ability to pull in long distance stations even under the most adverse conditions, is doing yeoman duty, until Victory will permit us to turn from our production of radio and electronic devices for our Armed Forces and resume the manufacture of finer radio receivers—at lowest Factory - To - You prices and at savings up to 50%.

MIDWEST RADIO CORPORATION
DEPT. 59-G ESTABLISHED 1920 CINCINNATI, OHIO

HOW JOE'S BODY BROUGHT HIM FAME INSTEAD OF SHAME



Charles Atlas

—actual photo of the man who holds the title, "The World's Most Perfectly Developed Man."

I Can Make YOU A New Man, Too in Only 15 Minutes A Day!

If YOU, like Joe, have a body that others can "push around"—if you're ashamed to strip for sports or a swim—then give me just 15 minutes a day! I'll PROVE you can have a body you'll be proud of, packed with red-blooded vitality! "Dynamic Tension." That's the secret! That's how I changed myself from a spindle-shanked, scrawny weakling to winner of the title, "World's Most Perfectly Developed Man."

"Dynamic Tension" Does It!

Using "Dynamic Tension" only 15 minutes a day, in the privacy of your own room, you quickly begin to put on muscle, increase your chest measurements, broaden your back, fill out your arms and legs. Before you know it, this easy, NATURAL method will

make you a finer specimen of REAL MANHOOD than you ever dreamed you could be! You'll be a New Man!

FREE BOOK

Thousands of fellows have used my marvelous system. Read what they say—see how they looked before and after—in my book, "Everlasting Health and Strength."

Send NOW for this book—FREE. It tells all about "Dynamic Tension," shows you actual photos of men I've turned from puny weaklings into Atlas Champions. It tells how I can do the same for YOU. Don't put it off! Address me personally: Charles Atlas, Dept. 1B, 115 East 23rd St., New York 10, N.Y.



CHARLES ATLAS, Dept. 1B, 115 East 23rd St., New York 10, N.Y.

I want the proof that your system of "Dynamic Tension" will help make a New Man of me—give me a healthy, husky body and big muscular development. Send me your free book, "Everlasting Health and Strength".

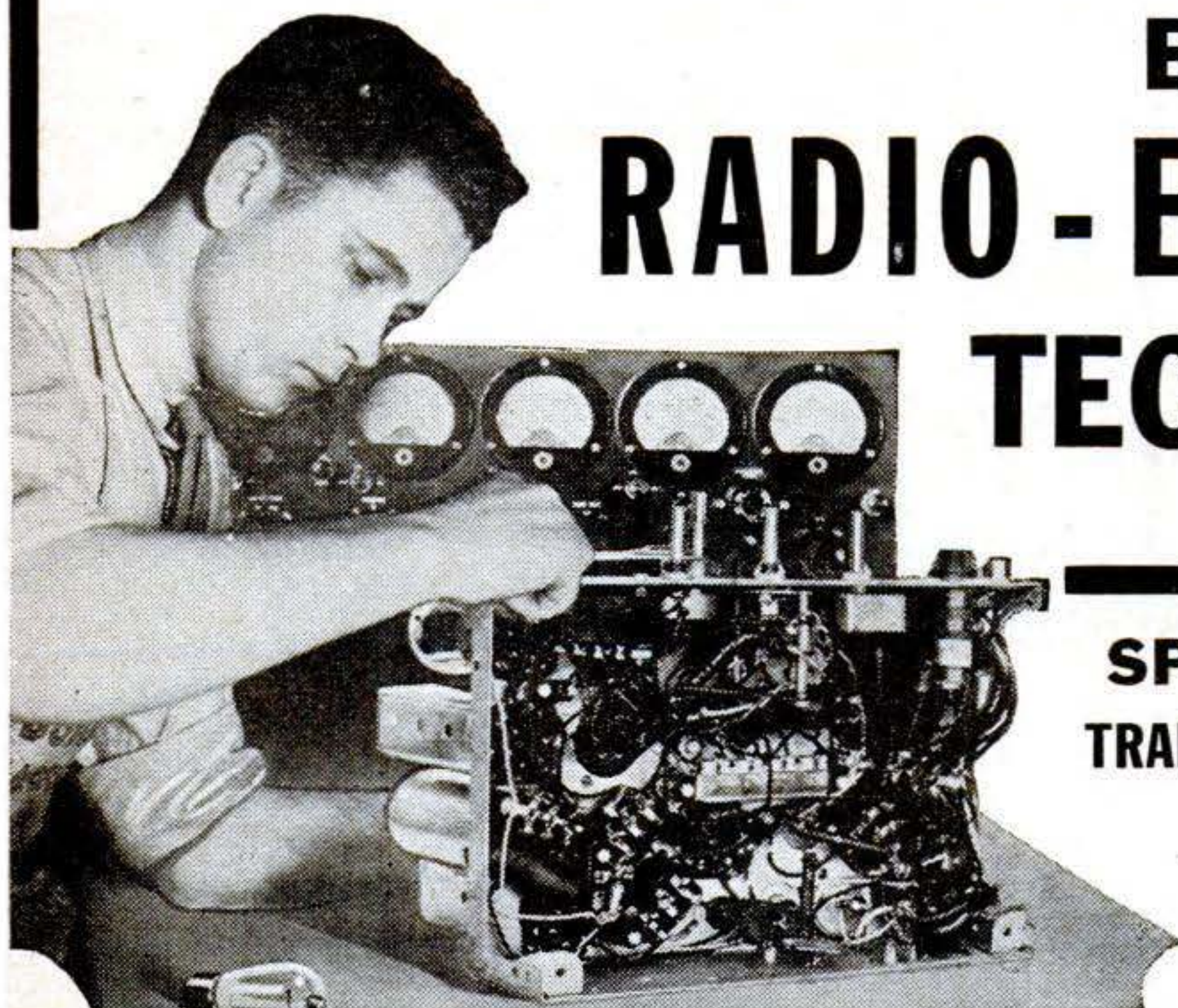
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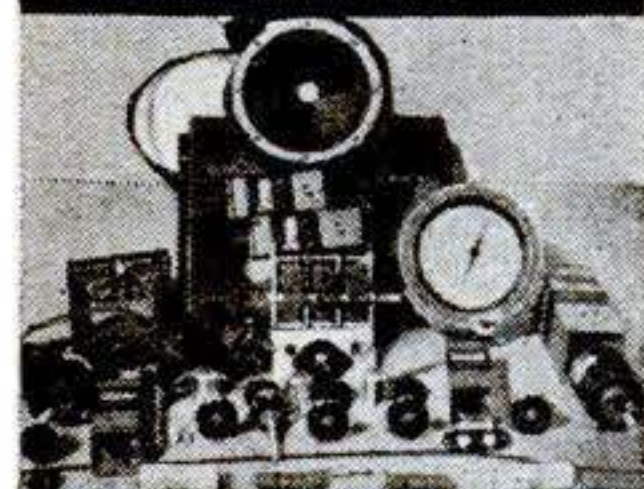
HERE IS YOUR SUCCESS CHANCE BE A RADIO-ELECTRONIC TECHNICIAN



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FOR WAR
AND
PEACETIME
WORK**



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FULL RADIO SET REAL EQUIPMENT**

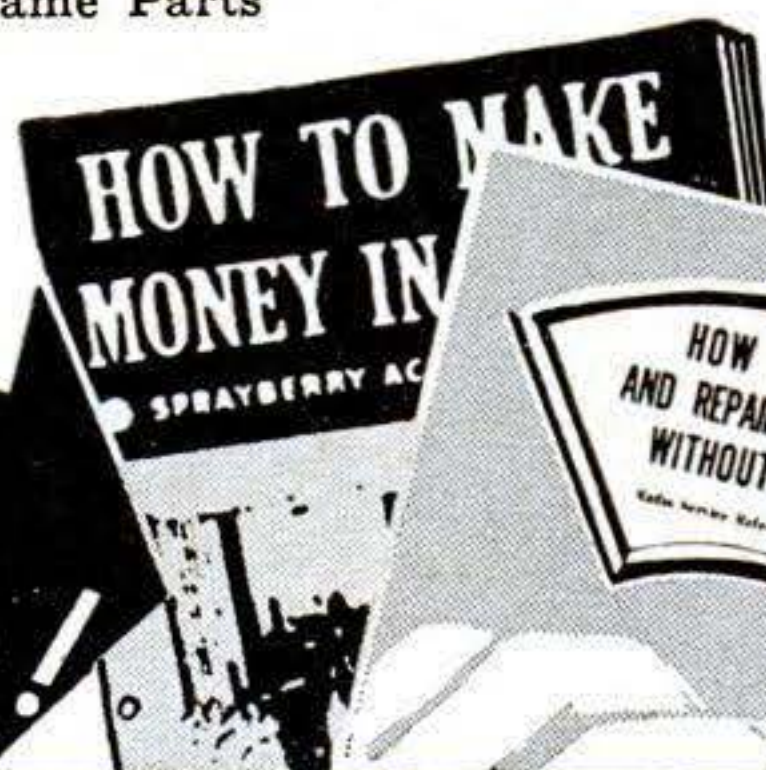


The offer I make you here is the opportunity of a lifetime. It's your big chance to get ready for a wonderful future in the swiftly expanding field of Radio-Electronics INCLUDING Radio, Television, Frequency Modulation, and Industrial Electronics. Be wise! NOW is the time to start. No previous experience is needed. The Sprayberry

course is short, intensive, and interesting. It starts right at the beginning of Radio. You can't get lost.

YOU GET A DUAL-PURPOSE RADIO SET

I supply you with Radio Parts which you use to gain pre-experience in Repair work. These same Parts are used for testing and for Signal Tracing, etc. You'll find my Course and Equipment fully described in the catalog offered below.



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for a Business of Your Own... or
Good Radio Jobs, Civilian or Military**

I make it easy for you to learn Radio Set Repair and Installation Work... by practical, proved, time tested methods. I teach you how to install and repair Electronic Equipment, and give you the broad fundamental principles so necessary as a background no matter what branch of Radio you wish to specialize in. Soon you'll be qualified for a good paying job in one of the nation's Radio plants doing war work OR, if you enter the Army, Navy, or Marines, my training will help you win higher rating and better pay. Let me prove what Sprayberry training can do for you.

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**"How to Test and Repair
Radio Sets Without Meters"**

Developed in the Sprayberry Laboratory, this instructive volume tells about an amazingly simple, yet efficient method for Radio trouble-shooting and repair without use of regular equipment made scarce due to war. Send for this FREE book now while the supply lasts and along with it I will send you another big FREE book describing my Radio-Electronic training.

**SPRAYBERRY ACADEMY OF RADIO
F. L. Sprayberry, President
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Please rush my FREE copies of "HOW TO TEST AND REPAIR RADIO SETS WITHOUT METERS" and "HOW TO MAKE MONEY IN RADIO."

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MAIL COUPON

INVENTORS

NOW Is the Time to PATENT and SELL Your Invention

Now, more than ever before, is the right time to patent your invention. Why? Because manufacturers everywhere presently engaged in war production are looking ahead to the future by buying up patent rights now, so they will have new and attractive items to make and sell for civilian consumption as soon as the war is over. This is what happened during and after the last war. Hence, the smart thing for you to do is to look ahead to the future too. Protect your invention by applying for a patent now, so you will be in position to cash in on an outright sale, or on the royalties your invention will bring.

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Our "Patent Guide for the Inventor" answers many important questions concerning Patents that inventors constantly ask. It tells what facts, details, drawings, sketches, etc. are necessary to apply for a Patent; how to protect your invention through dated and witnessed disclosure; how to do this AT ONCE to safeguard your rights; how Patent Office Records can be checked to determine whether the invention is probably patentable before filing fees need be paid; discusses costs involved and a practical way these can be paid as the application progresses. It tells how some inventors secured financial backing; how many simple inventions have proved large commercial successes; how Patents covering improvements also can be profitably utilized and marketed; tells countless other facts of interest.

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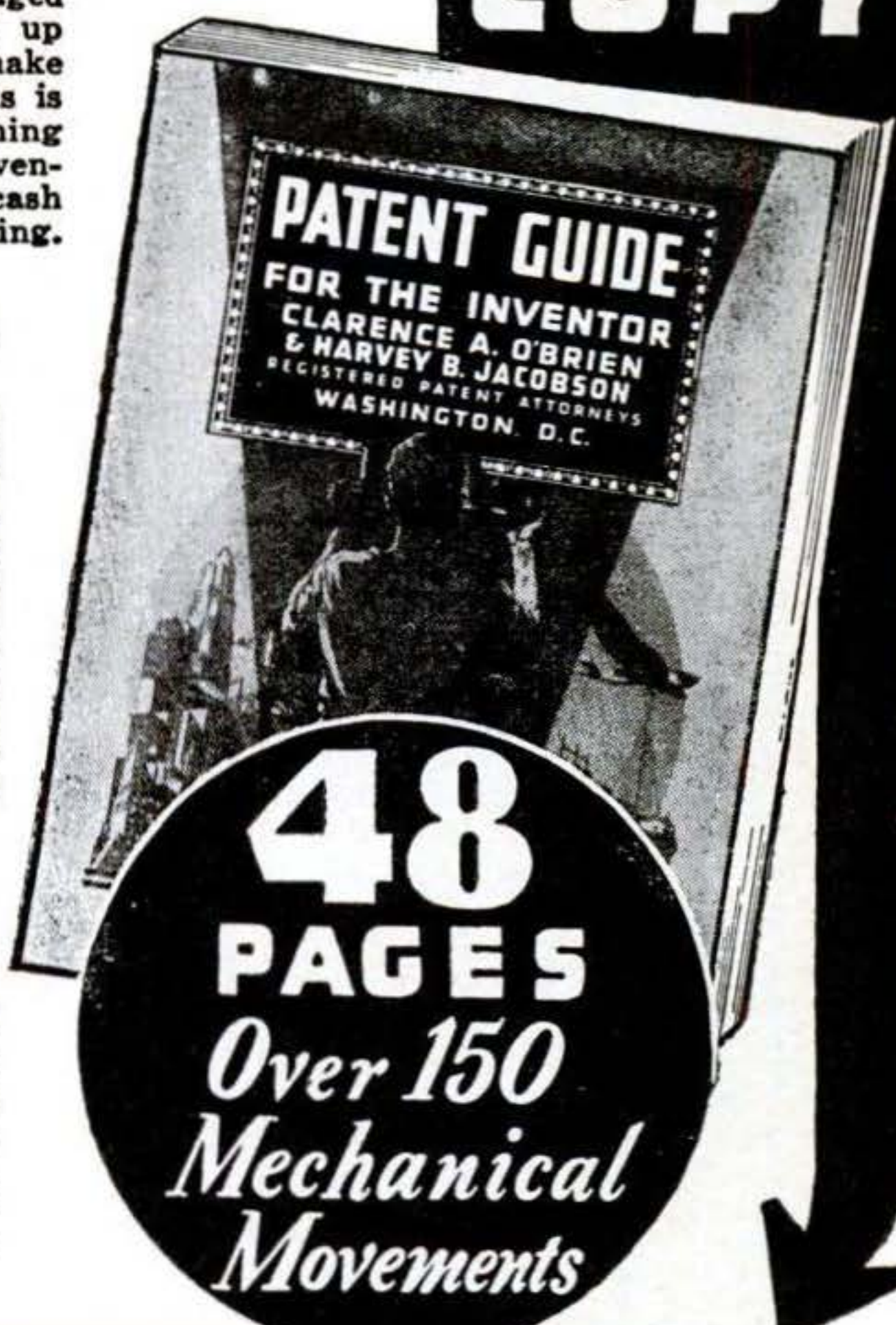
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Discovered in the Ozarks, this giant arrowhead was carved by early American Indians in commemoration of a bloody war with De Soto. See letter below

Biography of Pan American's Visible-Horizon Formula

I NOTE that in your November issue W. H. comments on the formula used by Pan American pilots to compute the distance of the visible horizon—the formula being to take the square root of the product of 1.5 multiplied by the height of the eye in feet, which will give the distance of the visible horizon in miles. You may be interested to know how this formula was arrived at. The earth's curvature is approximately eight inches from mile to mile. Using the geometric law that the square of the unit distance multiplied by the drop per unit distance gives the total drop, we get this formula: $D^2 \times \frac{2}{3} = H$ (where D equals unit distance; $\frac{2}{3}$ represents the eight inches, or two thirds of a foot; and H is the height, or distance, of the total drop in feet). This formula, arranged to find the value of D, reads: $D = \sqrt{\frac{3}{2} \times H}$, or $D = \sqrt{1.5 \times H}$, which is the formula now in use by the pilots.—J. H. B., Topock, Ariz.

Here's War Work Which Really Does Some Good

YOUR readers with home workshops can do one kind of war work which will mean a lot. By using their power tools, they can easily make up rough whittling kits—or other handicraft projects—to occupy convalescent soldiers and sailors in our hospitals. It doesn't take long to bandsaw a blank for a carved figure or plane-recognition model, and

Readers Say:

the effort is small compared with what it might mean to some wounded youngster with time on his hands. Knocked-down boxes and simple footstools suitable for chip carving are other possibilities. To be certain his contribution will be what's wanted most, a hobbyist should get in touch with the medical officer in charge of rehabilitation at the nearest military or naval hospital.—H. V. C., San Francisco, Calif.

Any Ideas on How to Blow Hot on Cold?

WINTER is here—and so is the freezing of water pipes. Do you suppose any of the "nuts" in Readers Say have an idea on how to make a small electric thawing device? I don't mean one of those large ones that thaw out four-inch, or even larger, pipes, but a small one hot enough to handle half-inch pipe that happens to be laid in places hard to get at with a blowtorch. I would also want one that could be plugged in on a regular house circuit.—C. E. H., Jerome, Ariz.

Giant Arrowhead Found After 400 Years

I AM sending you a photograph of a giant arrowhead that I uncovered in the Ozark Mountains. It is 47 inches high, 30 inches wide at the base, 19 inches wide at the

GREAT SECRET—



neck, and has a maximum thickness of $4\frac{1}{2}$ inches. It is definitely not a freak of nature. I was told about the stone by a full-blooded Indian over 15 years ago. I doubted its existence and thought it just a legend, but I recently found it just below the surface of the ground where it had been planted to

mark the entrance to a cave. Made of limestone, the arrowhead is a ceremonial stone that was carved to commemorate a bloody Indian war with Hernando De Soto and his band of 2000 warriors between the years 1538 and 1541.—E. N., Springdale, Ark.

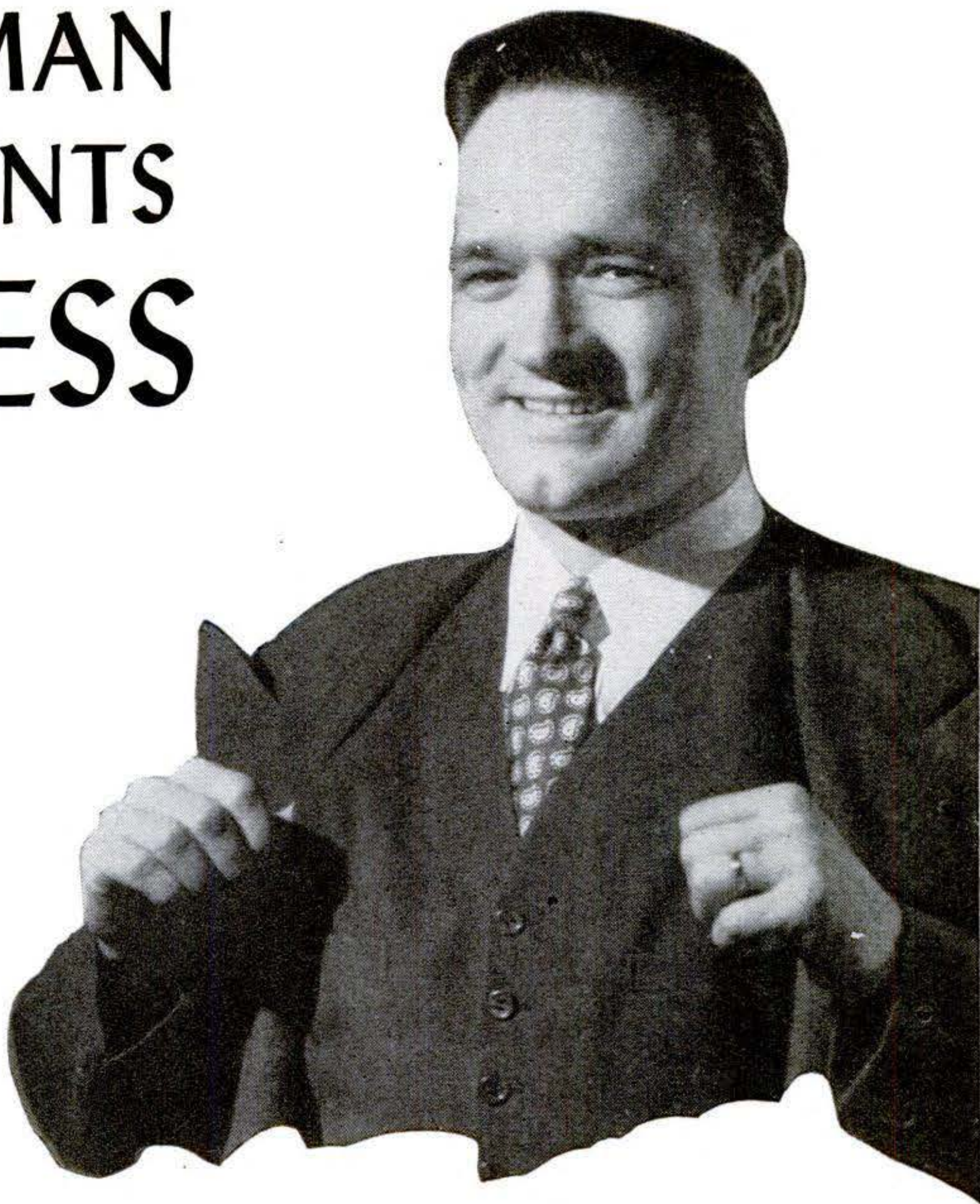
TO THE MAN WHO WANTS SUCCESS

after the WAR!

If you want success and security when peace comes, prepare for it now. Make sure that you have the trained ability that employers will want and pay for in the post-war adjustment.

As business converts back to civilian goods, there will be urgent call for accountants, bookkeepers, salesmen, sales and credit correspondents, traffic managers, marketing men, secretaries, office managers and legally trained executives.

For 35 years, LaSalle has been training adults in their spare time for such positions.



It knows how. It can train you—quickly, thoroughly, at moderate cost, without interruption to your present work.

Mark the coupon below for our free booklet about the field of your interest. It costs nothing to get the facts and they may lead you to larger security and success—now and after the armistice whistles blow.

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- ☐ Stenotypy: machine shorthand

- ☐ Traffic Management
- ☐ Executive Management
- ☐ Foremanship
- ☐ Industrial Management

Name.....Age.....

Position.....Address.....

City and State.....

Readers Say:

You Realize, of Course, Sir, That This Is War

IN YOUR November and December issues, you have omitted the usual complete table of contents. Since I have been keeping these



on file according to subject, I would appreciate it if you would include it in future issues. I am sure other readers would also like to have it.—L. C. S., Passaic, N. J.

Despite our limited supply of paper, caused by wartime rationing, our editorial, advertising,

and contents matter have been fighting tooth and nail for the same space that each was formerly allotted. So far we have been able to get only the table of contents to compromise.—Ed.

A New Light on the Traffic Problem

I HAVE an idea for a stop light that would be connected with the regular rear stop light, but which would be placed on the front of the car. This front light, I believe, would promote safer driving, particularly at night when hand signals are next to useless. Suppose you are approaching an intersection on a boulevard protected by "stop" signs and see a car coming at you from the right. If you see its light go on, you know that the driver has his foot on the brake instead of the throttle, and is going to stop. Farther on, you see a car coming at you in the center line of traffic. If his light goes on, you know that he intends to make a left-hand turn. Is he going to give you the right of way? Or is he going to try to shoot in front of you? The answer to the latter is "no," for you see that his light is still on. If you are a pedestrian, you can always know the intentions of

an approaching car by looking to see if its front stop light is on or off. I feel certain that such a device would prevent many accidents and fatalities.—F. E. L., Los Angeles, Calif.

No Argument. He's Got Us Dead to Rights

ON PAGE HW 576 of your November issue you refer to freeze-out plugs in an auto block. This idea seems to have spread through many sections of the country, but I hardly expected a mechanic to make such a mistake. The so-called freeze-out plugs have no more to do with freezing than the buttons on your shirt. These spots on the side of a block or head (usually in the form of a boss) are put there as a step in manufacture, and are solely to hold the sand core securely in the flask while the job is poured.—H. A., Carthage, Mo.

You've got us dead to rights, H. A. Various-ly referred to as welch plugs, core plugs, expansion plugs, and freeze plugs, they give a cylinder block scant protection against damage from freezing. Their principal purpose is to close off holes left to permit the core sand to be cleaned out.—Ed.

He'll Start the Business —You Bring the Chickens

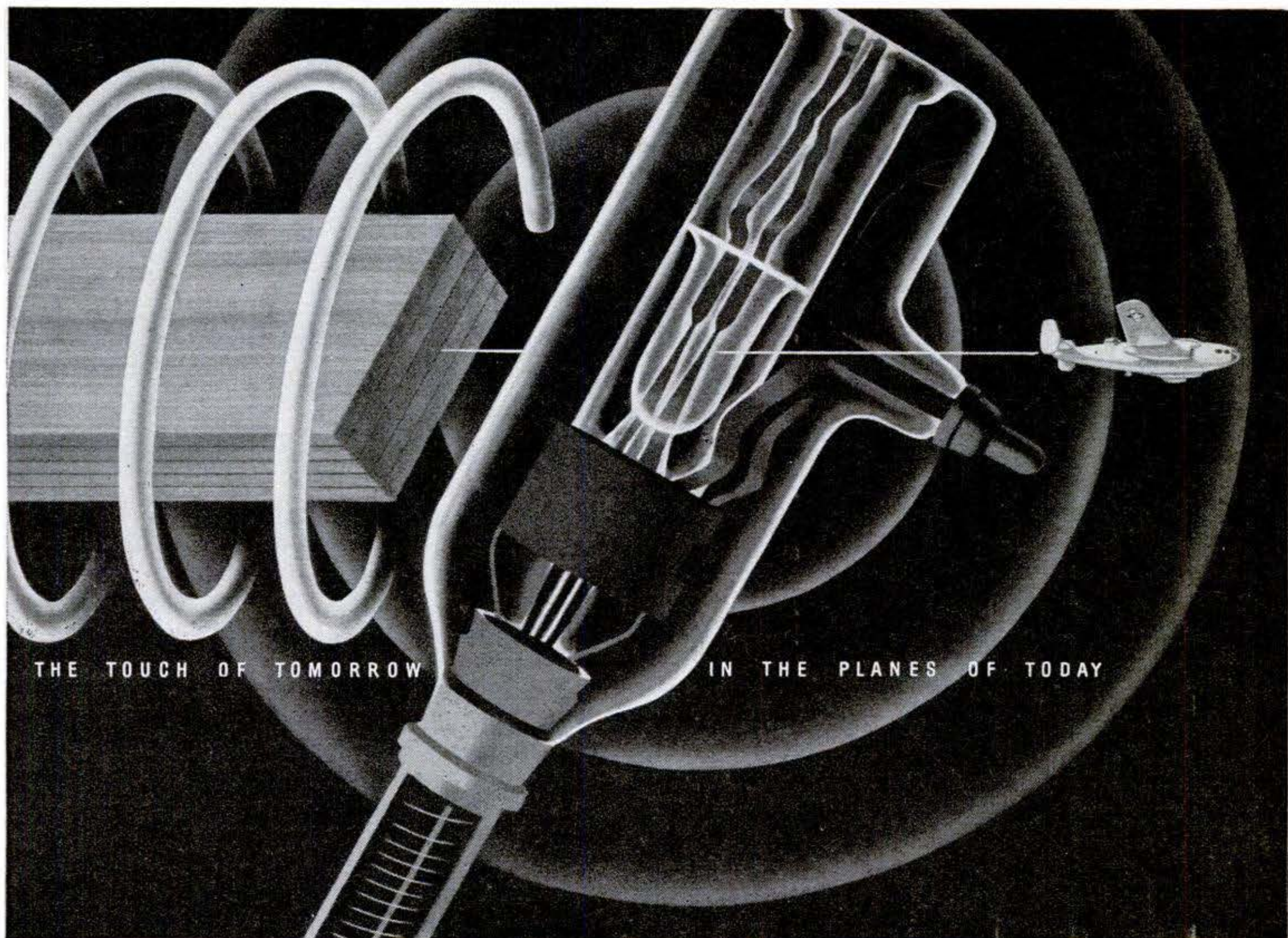
I HAVE just discovered a scheme for getting rich quick. The war brings about that opportunity. I propose to start a chain of "au-gratin" joints. Today I went into a local

BETTER'N I EXPECTED—
AT LEAST I CAN WISH FOR
SOME CHICKEN



cafe. There was practically no meat listed on the menu, so I selected chicken with macaroni au gratin. And Oh Boy! was I chicken-hungry! When finally served, I began to explore the contents. I searched for some time in that dab of macaroni for some sign of chicken, and finally located two

small pieces which could best be seen with an electron microscope. I decided it was a game in which if you tasted chicken flavor you won. I lost. If any reader is interested in a partnership, I will be glad to supply a carload of macaroni au gratin for every chick that he can produce. I guarantee we'll be millionaires in a week.—A. B. C., Stockton, Calif.



New Magic from the Mysterious Electron

Through X-ray, the unfathomable electron has saved millions of lives. Through radio, it has extended man's hearing to every corner of the world. Through television, it permits him to see beyond all previous limits of sight.

And now Fairchild's Duramold engineers have harnessed the electron to a new and urgent task—the manufacture of aircraft components.

The usual plywood techniques for joining thin layers of wood could not be applied in making highly stressed, thick sections. New methods were needed—in a hurry.

Duramold engineers found the solution in electronic energy, employing radio high frequency with

apparatus similar to that used by radio stations in sending out short wave broadcasts.

Heat generation by radio frequency, coupled with special adhesives, now turns out better, stronger aircraft parts. And the production cycle has been clipped from hours to minutes. The use of electronics is becoming a new and important technique in Duramold's process for assembling molded wood structures.

Thanks to the ingenuity of Fairchild engineers, with their flair for getting the "touch of tomorrow in the planes of today," a new technique has been successfully applied toward the common goal of turning out stronger planes—and doing it faster.

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FEBRUARY, 1944

Buy War Savings Bonds and Stamps regularly.

19

In Your Mind's Eye

The Secret of MENTAL CREATING

IF you just like to dream, read no further. There comes a time when your fancies *must be* brought into light—and stand the test of every-day, hard realities. Are you one of the thousands—perhaps millions—whose thoughts never get beyond the stage of *wistful wishing*? Do you often come to from a daydream with the sigh, “If only I could bring it about—*make it real*?”

All things begin with thought—it is what follows that may take your life out of the class of those who hope and dream. Thought energy, like anything else, can be dissipated—or it can be made to produce actual effects. *If you know how to place your thoughts* you can stimulate the creative processes within your mind—through them you can assemble things and conditions of your world into a happy life of accomplishment. *Mental creating* does not depend upon a magical process. It consists of *knowing how* to marshal your thoughts into a power that draws, compels and organizes your experiences into a worth-while design of living.

ACCEPT THIS *Free* BOOK

Let the Rosicrucians tell you how you may accomplish these things. The Rosicrucians (not a religious organization), a world-wide philosophical fraternity, have preserved for centuries the ancients' masterful knowledge of the functioning of the inner mind of man. They have taught men and women how to use this knowledge to *recreate their lives*. They offer you a free copy of the fascinating book, “The Mastery of Life.” It tells how you may receive this information for study and use. Use coupon opposite.

The ROSICRUCIANS
(AMORC)

SAN JOSE

CALIFORNIA

SCRIBE: V. Z. A.
The Rosicrucians (AMORC),
San Jose, California.

Please send free copy of “The Mastery of Life,”
and I shall read it as directed.

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Address.....

City.....

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PLASTICS ENGINEERS AND TECHNICIANS NEEDED
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● Leaders in science and industry have long been saying, "Keep your eye on Plastics." But now the time for action has arrived. The future of huge possibilities has already begun. Developments in Plastics for hundreds of wartime uses have set the pace for revolutionary changes in peacetime production of thousands of products.

THIS IS YOUR BIG CHANCE

Today there's a big need in vital war production for those who are trained in Plastics. From one to a hundred articles made of Plastics must be supplied for every man in our fighting forces. Start training now in Plastics Engineering, in spare time in your own home. Fit yourself for a responsible, well-paid position. Help to win Victory. And at the same time you will be preparing for even greater opportunities when the war is over.

There is scarcely an industry in which these so-called "miracle materials" will not play an important part. After the war many old materials, methods and skills will be replaced. Acquire the all-important "know how." Be in a position to step into one of the key jobs.

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Turn at least part of your leisure time into money. Qualify at home for a larger income in an interesting career. Build greater security for your future in a vocation that looms large on the horizon of the new industrial era. Hours you might otherwise waste can put you well on your way toward lasting success.

It's easy to find out about Plastics training. To get details and outline of study prepared by specialists, and about the school that has helped thousands to success during the past 46 years, write us or check and mail the coupon. Send today. The sooner you take this easy step, the sooner you will reach your goal and reap the rich rewards.

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AMERICAN SCHOOL

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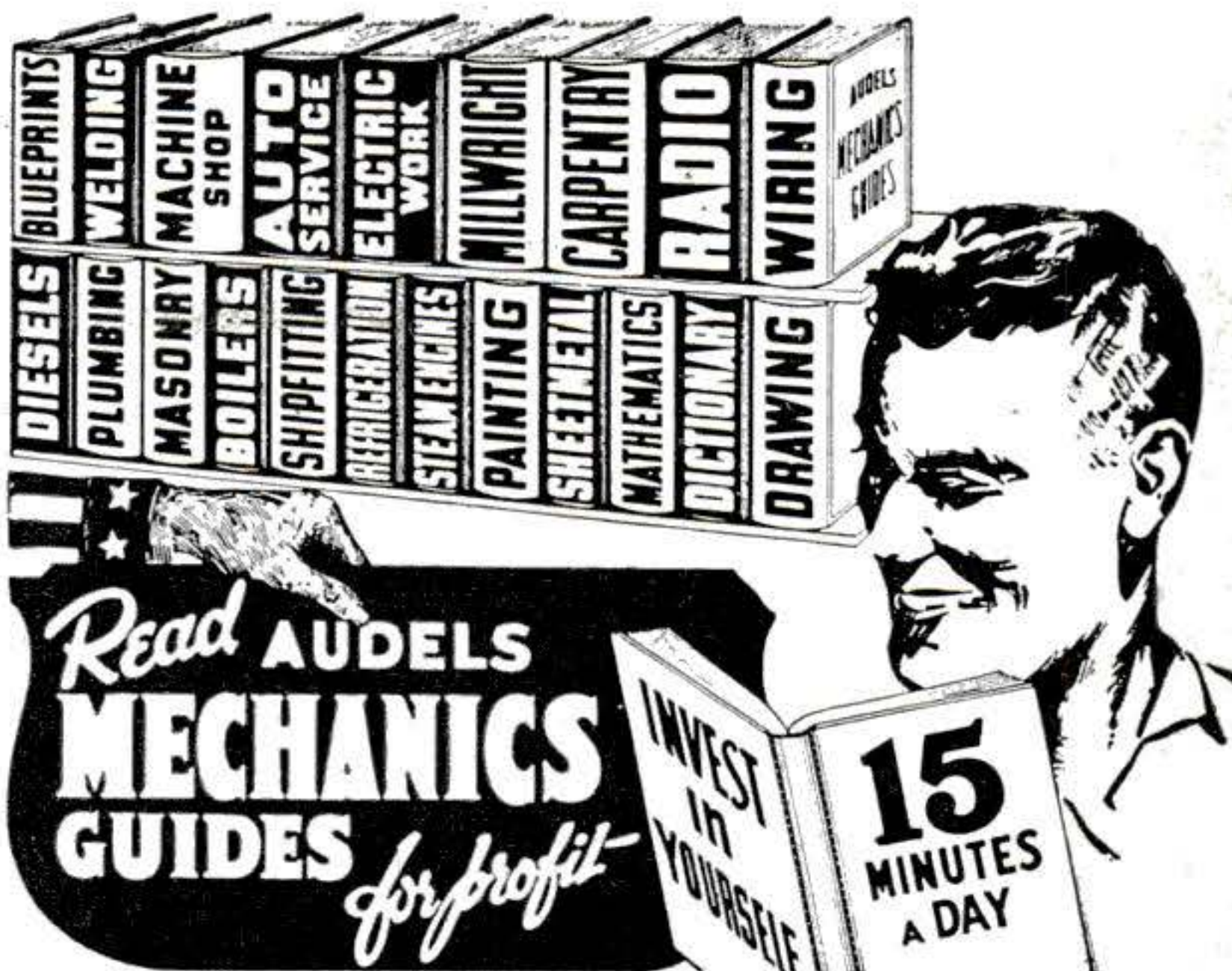
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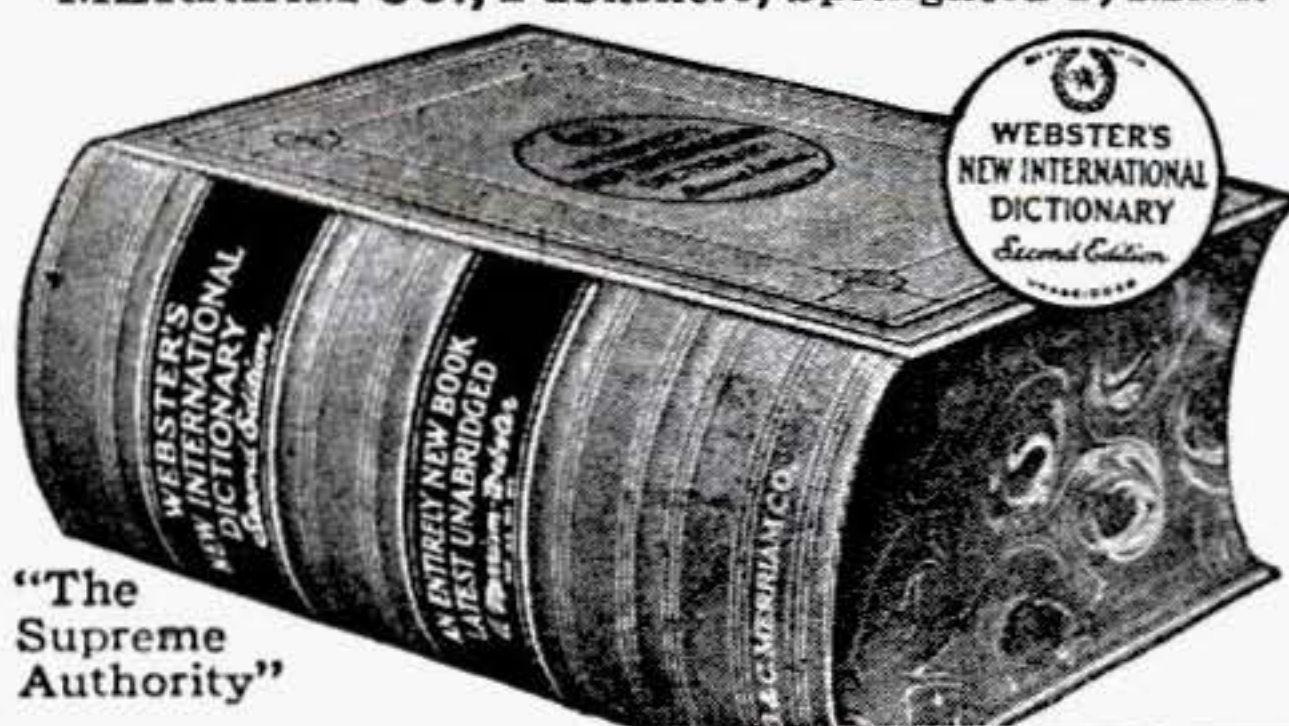
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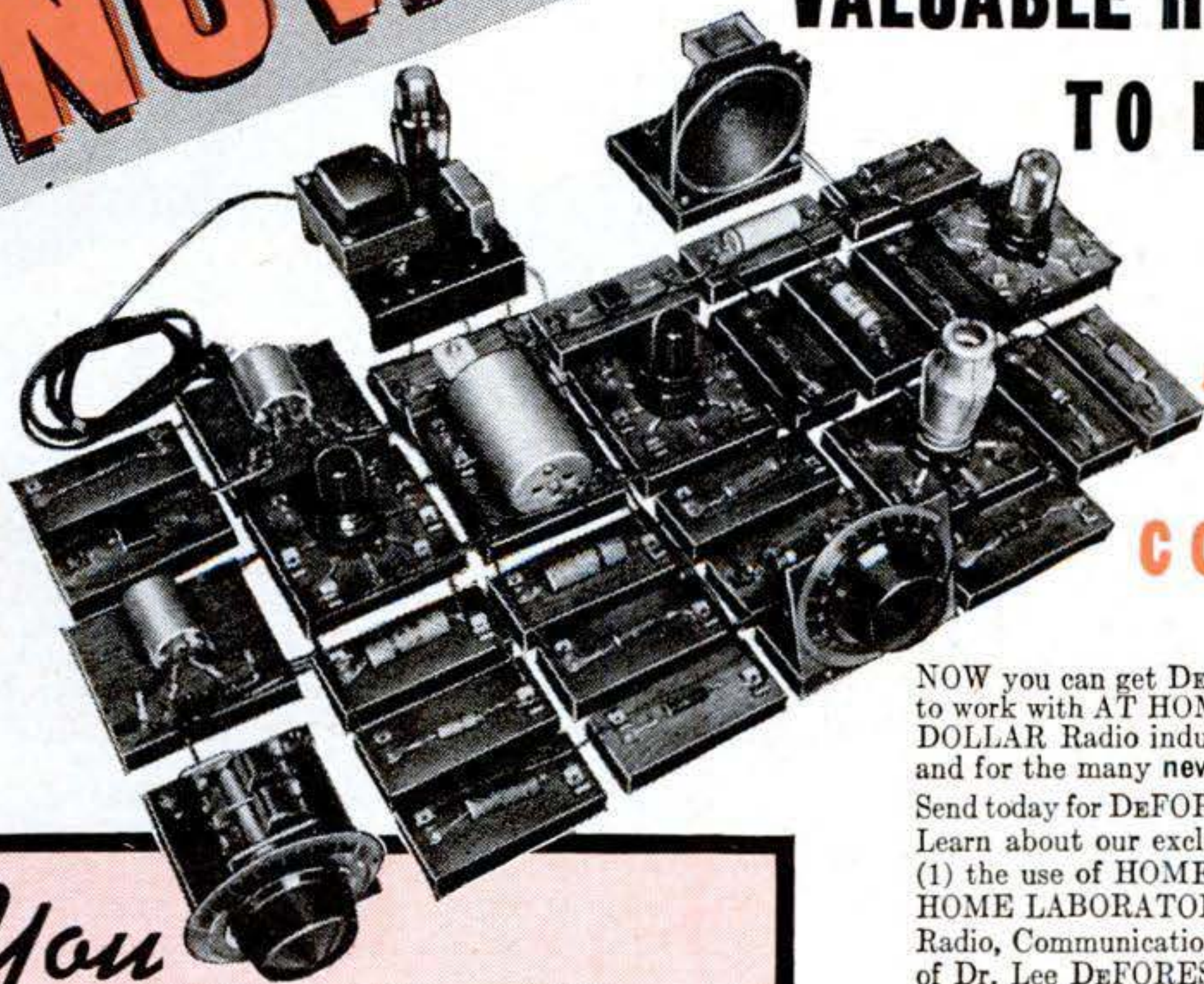
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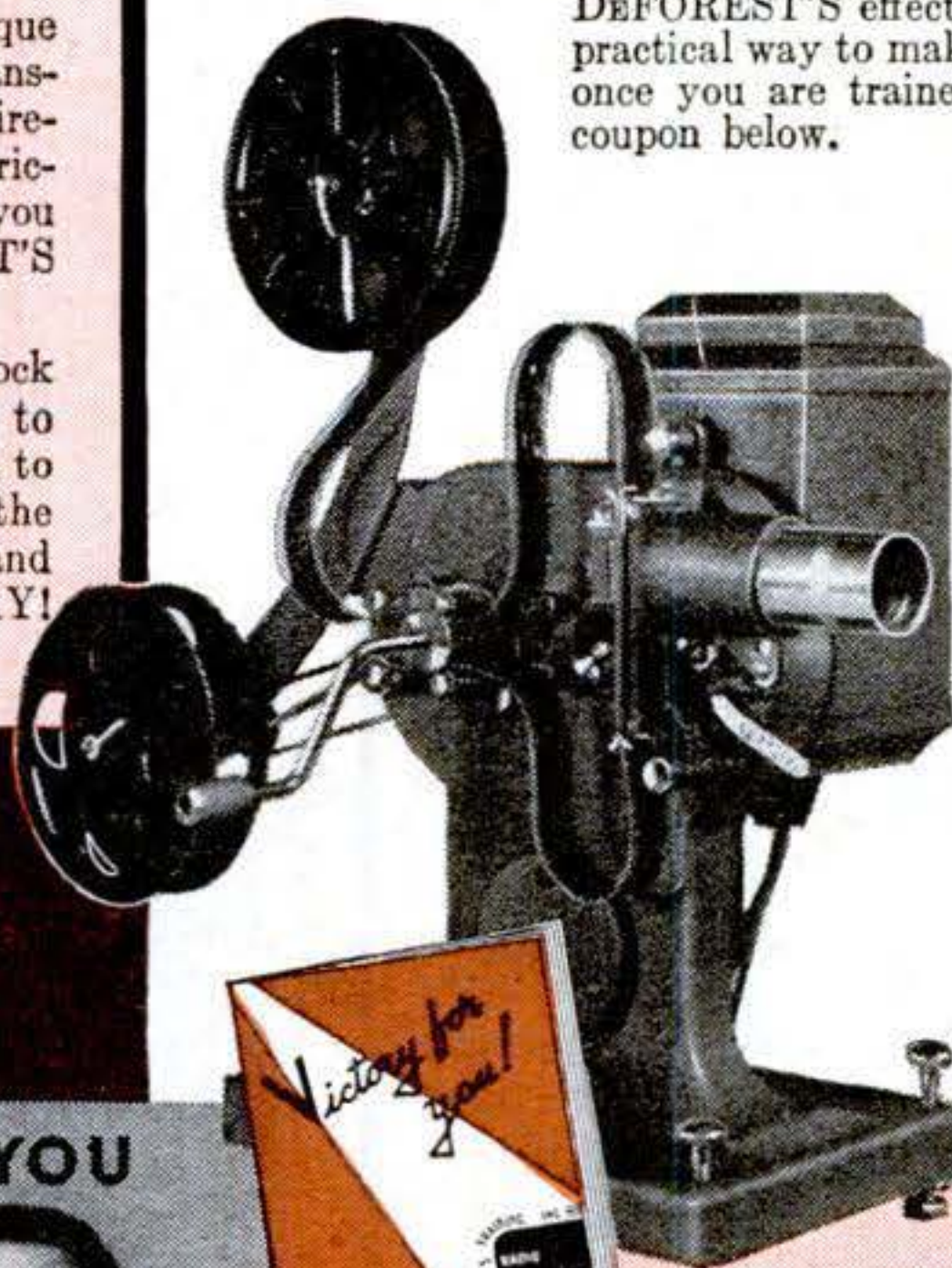
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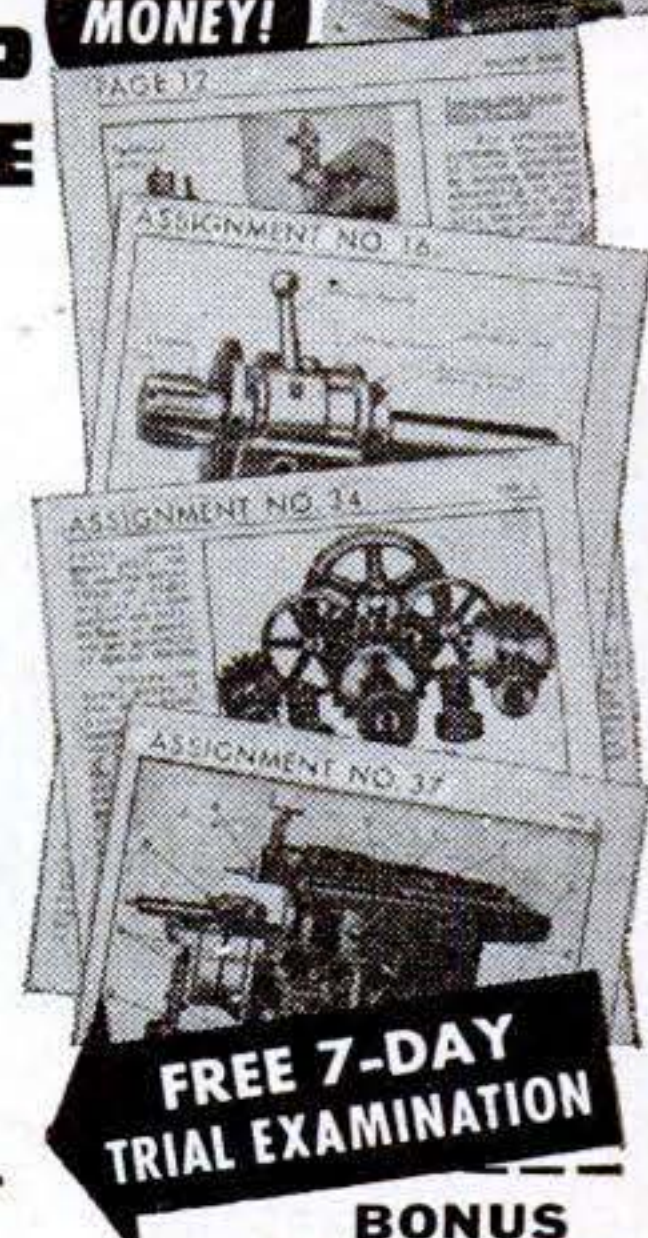
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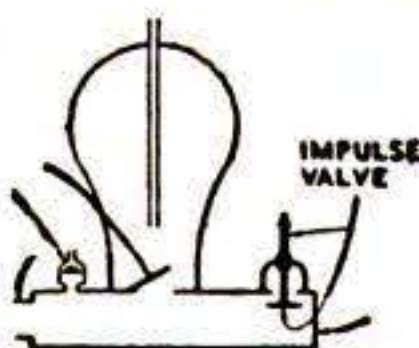
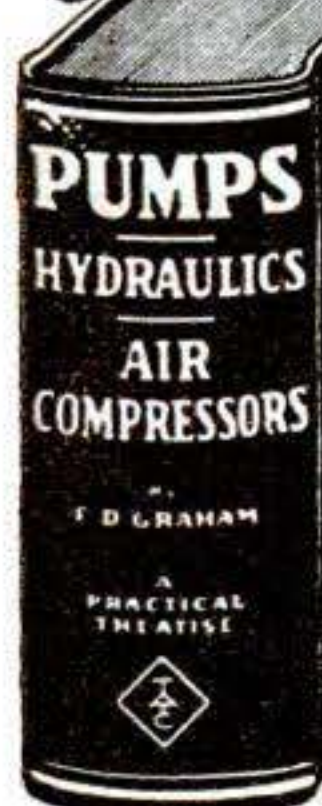
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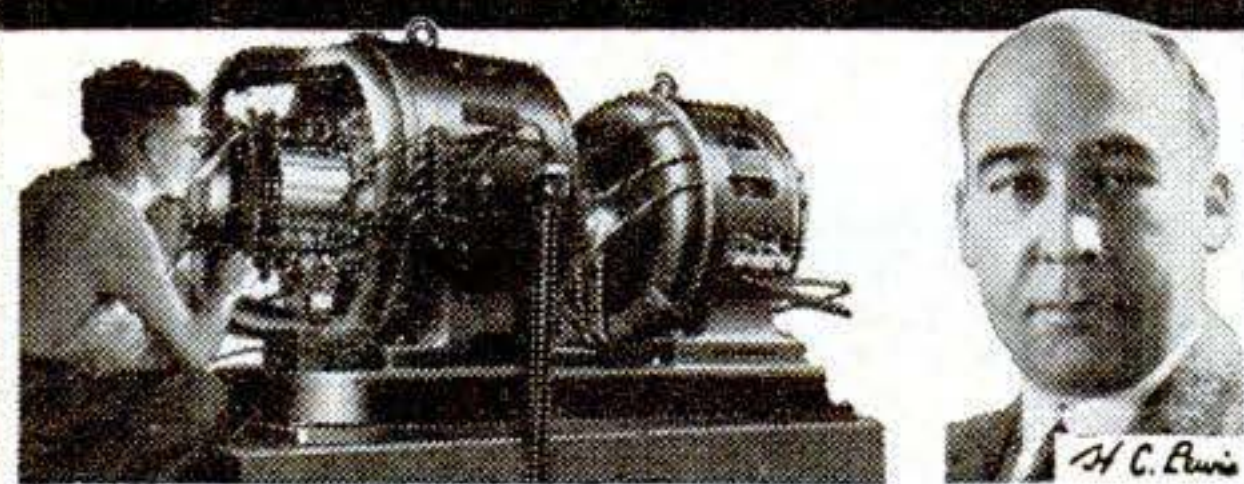
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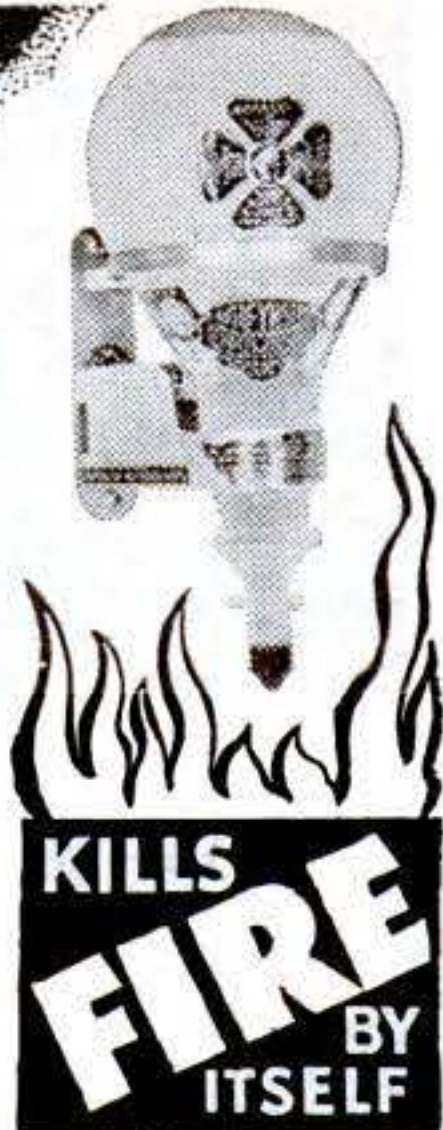
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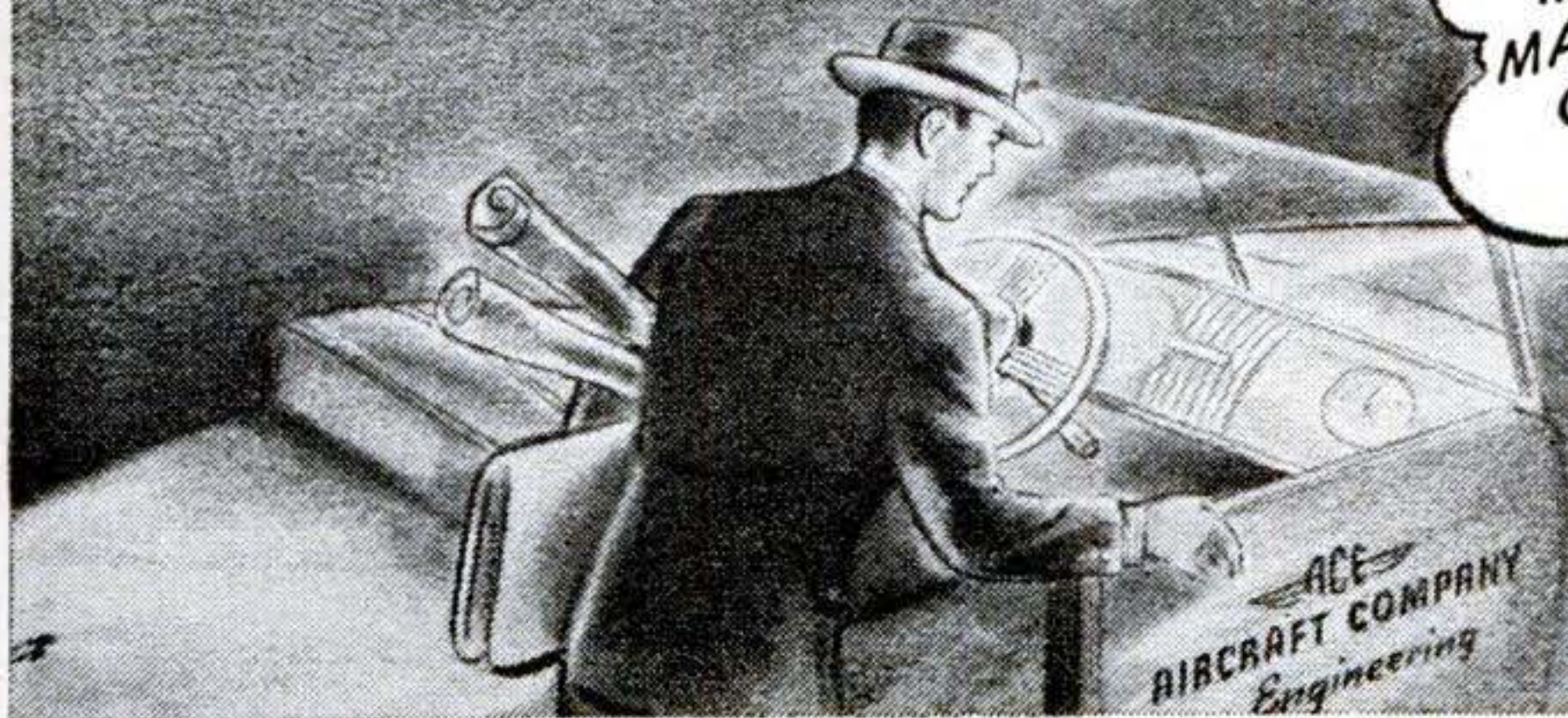
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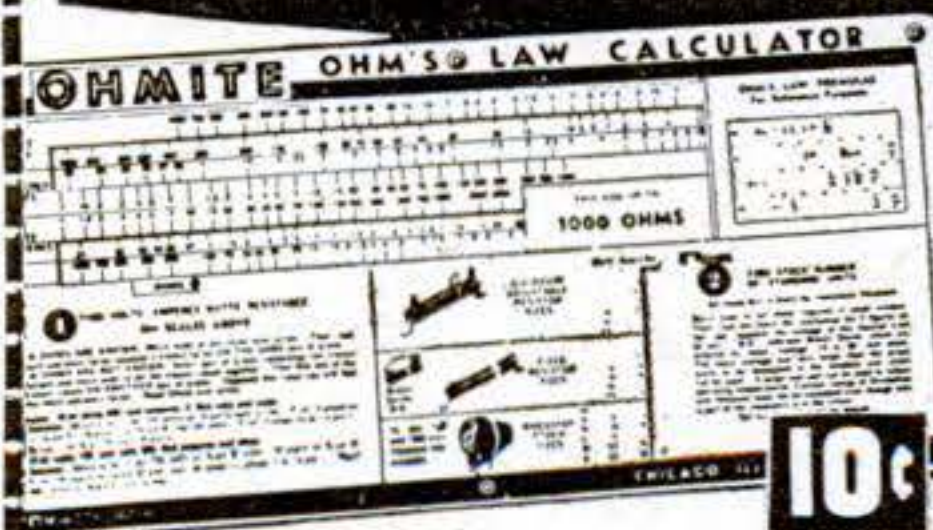
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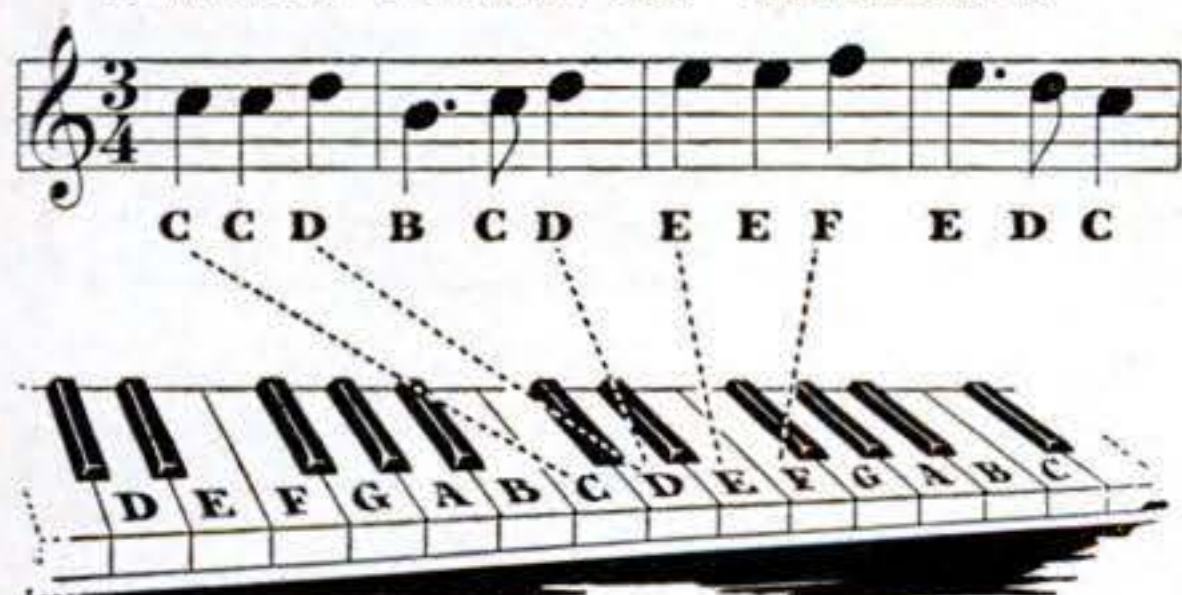
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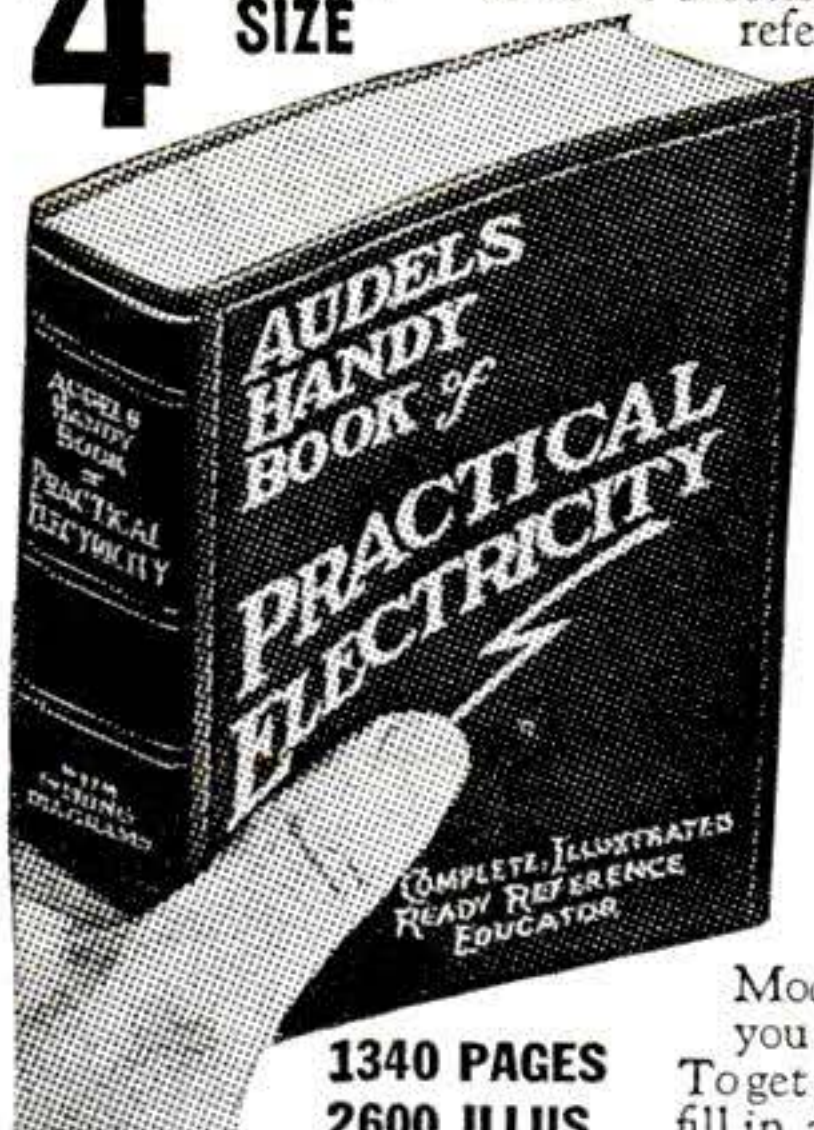
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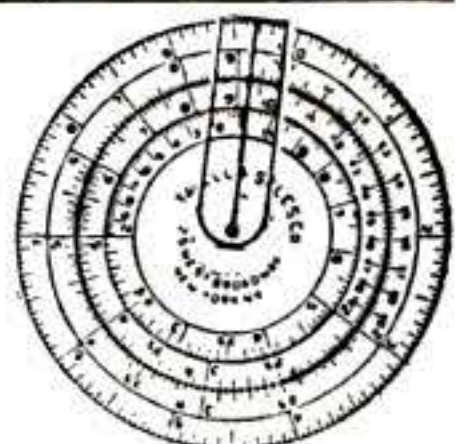
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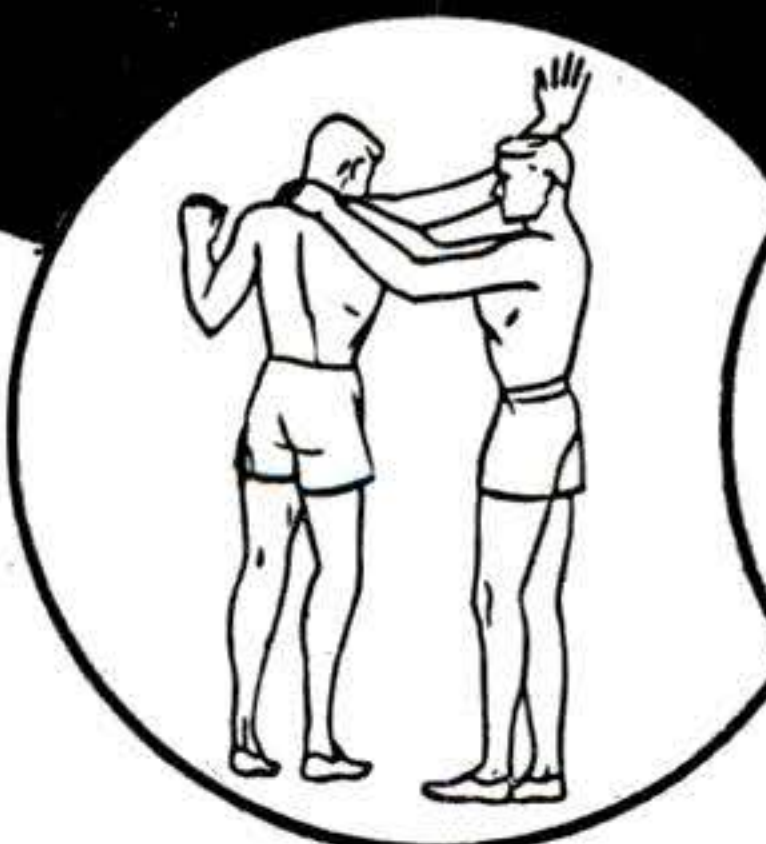
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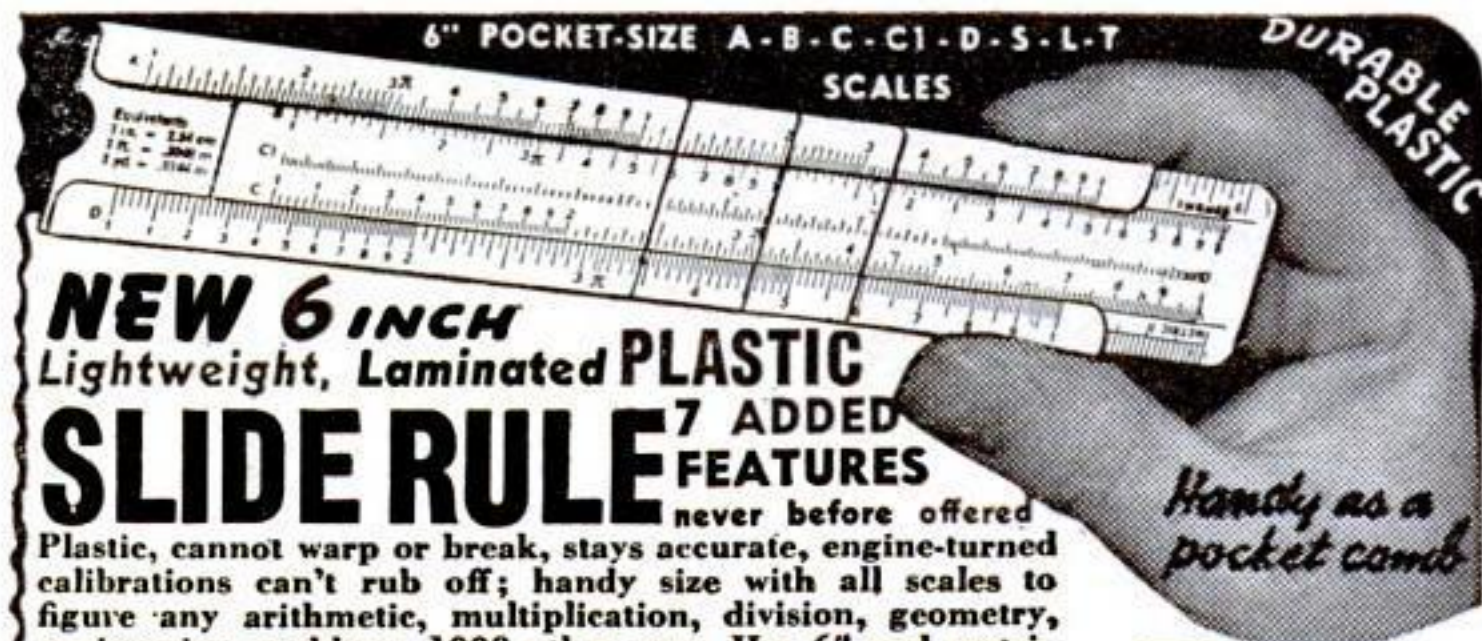
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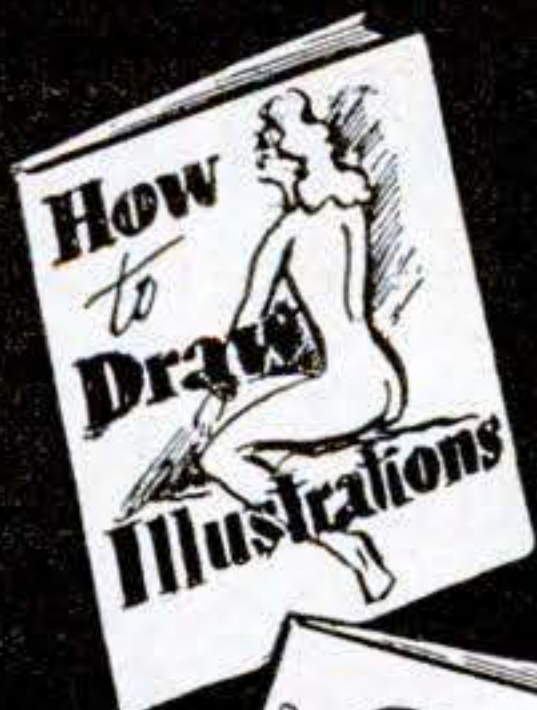
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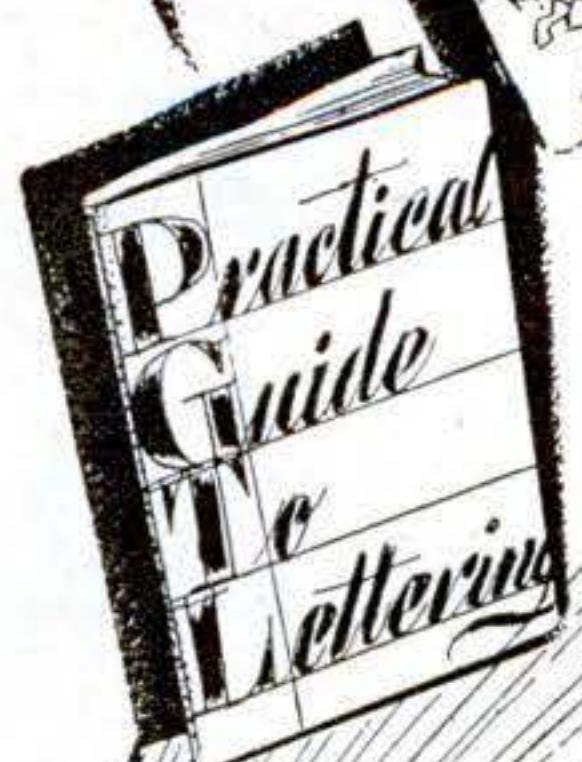
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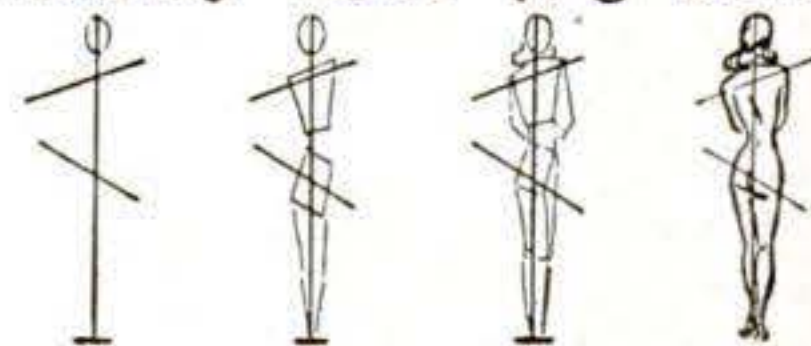


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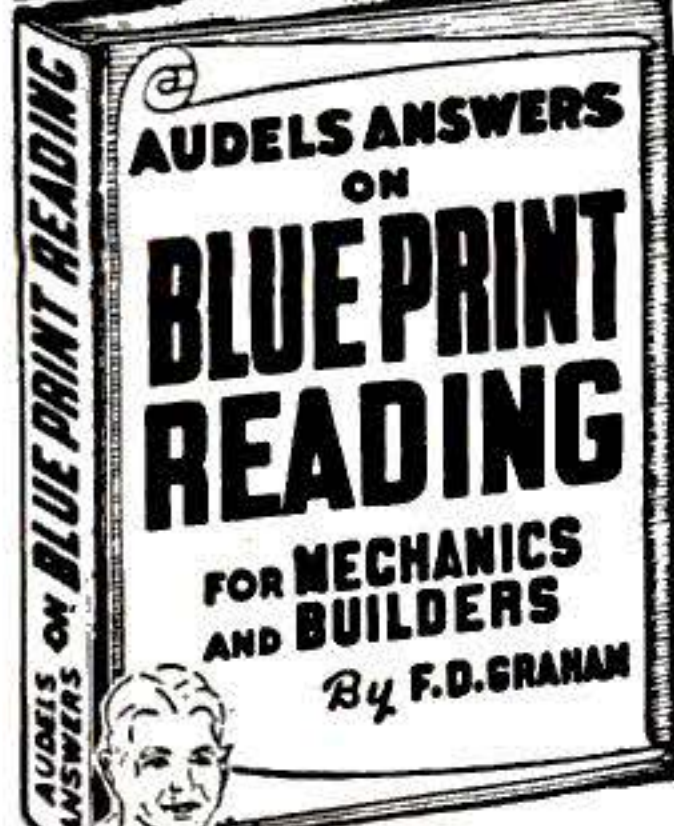
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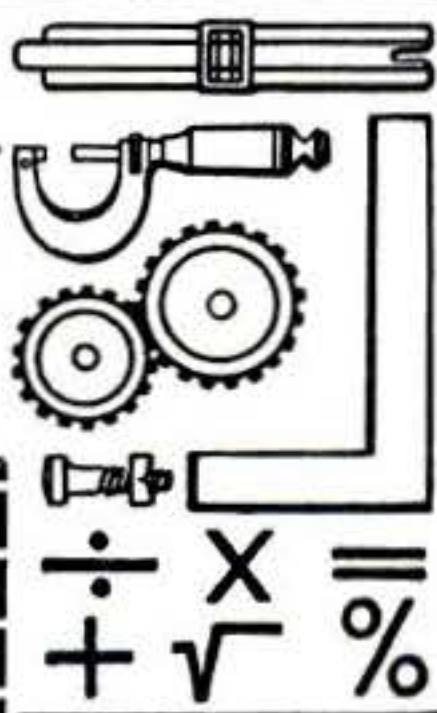
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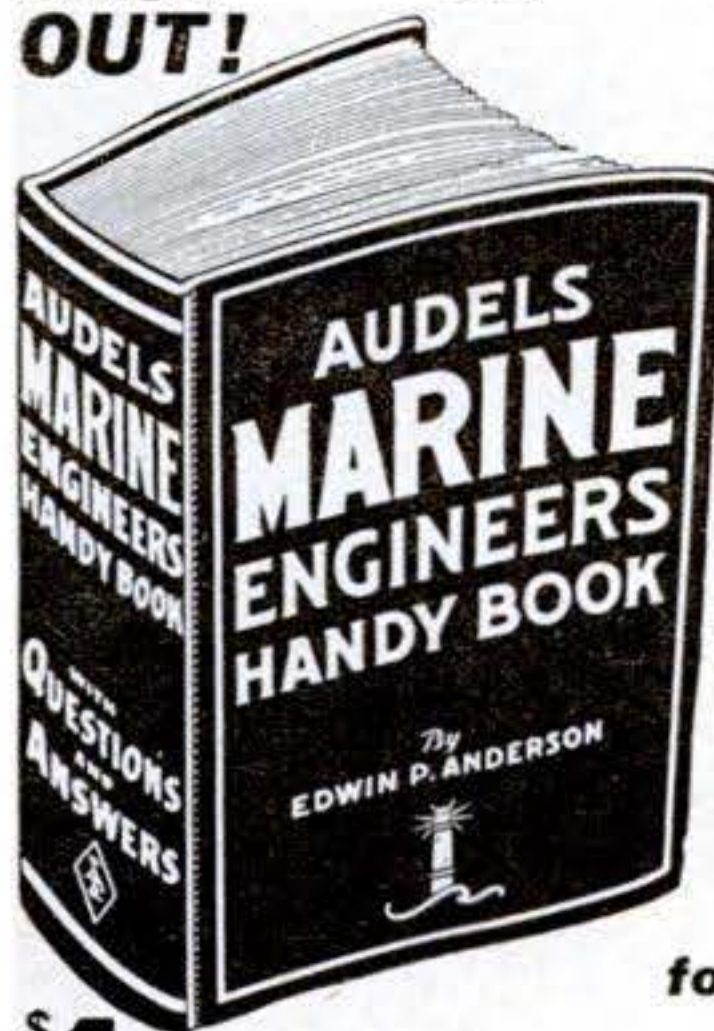
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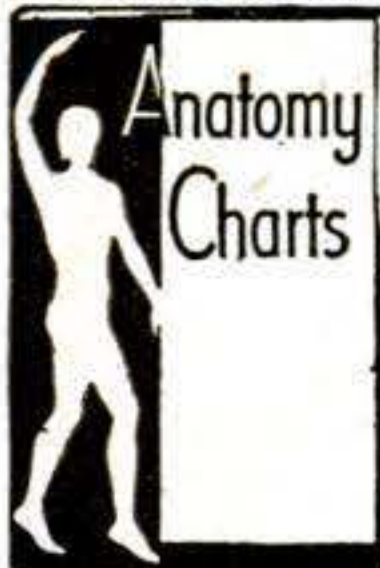
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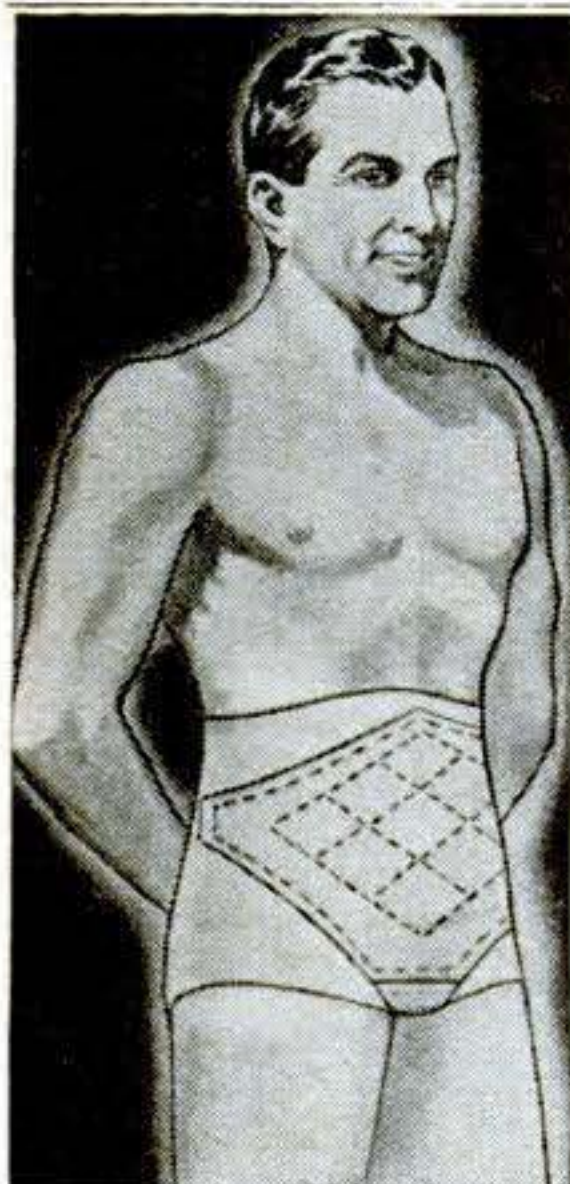
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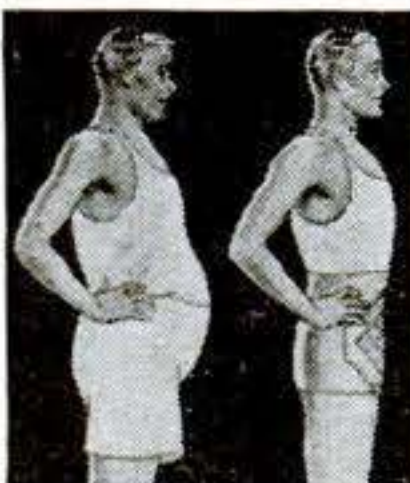
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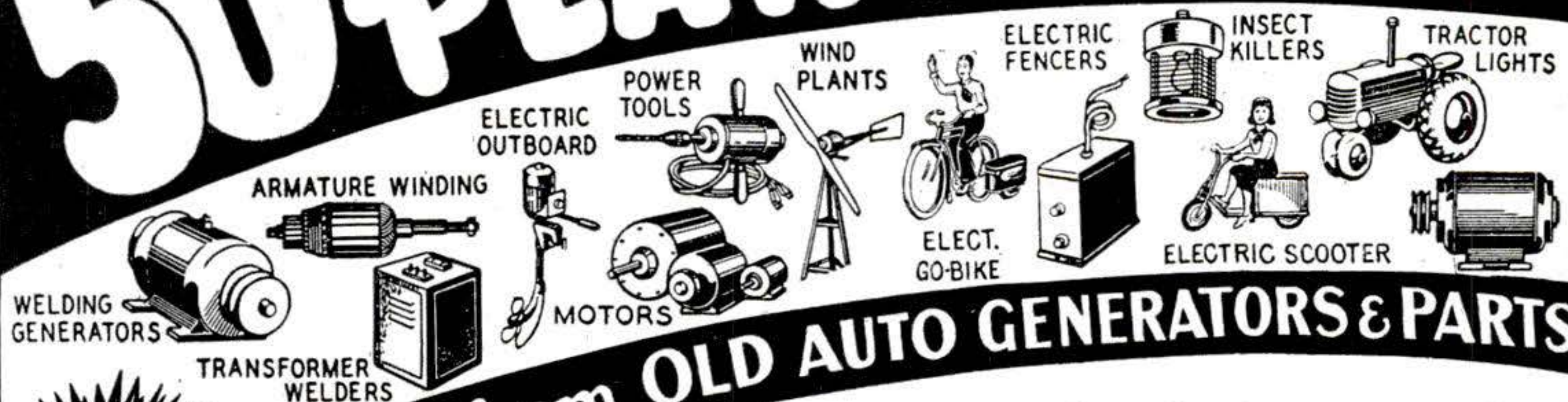
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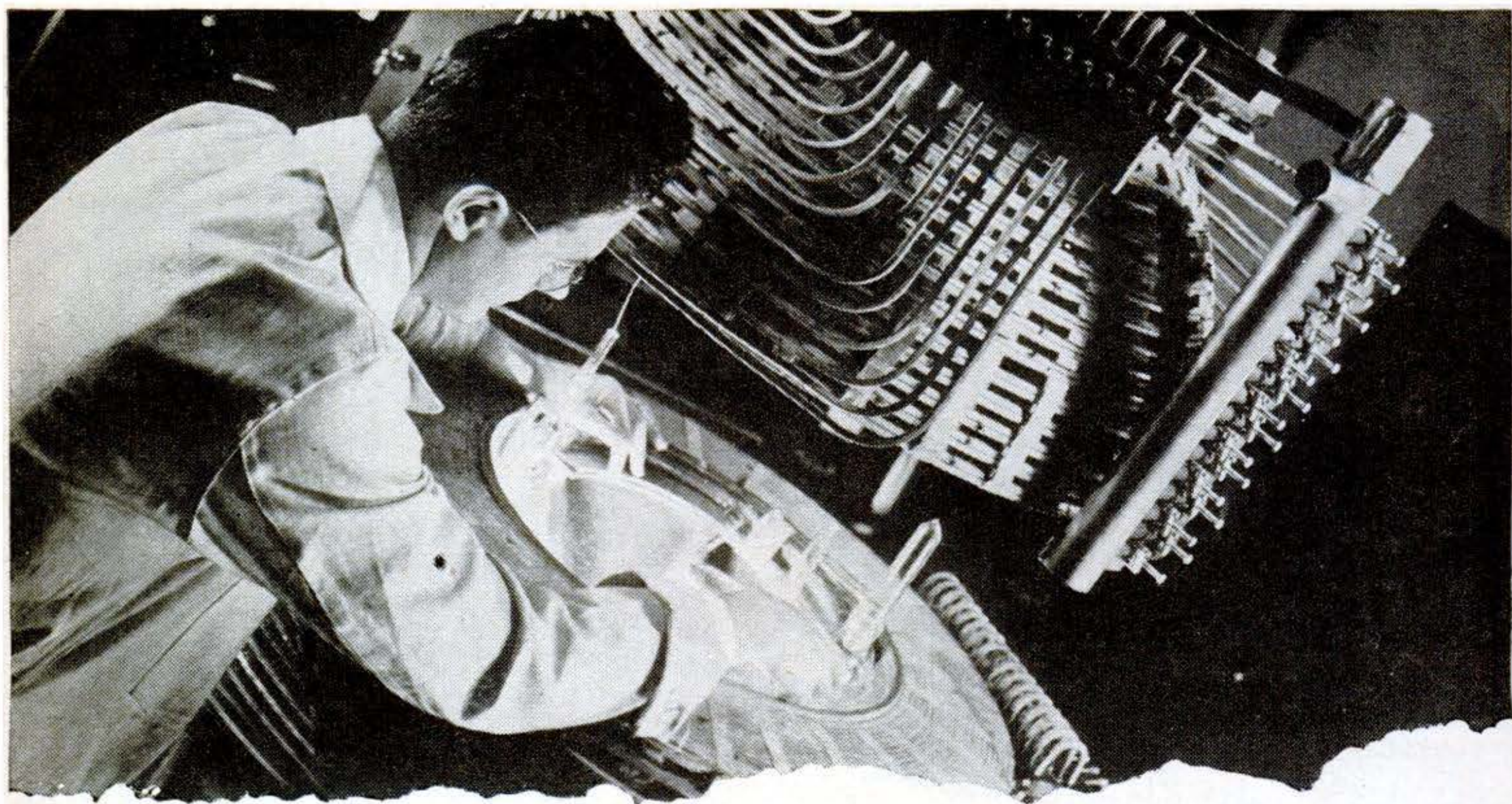
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Helping the tire maker: Pictured here is a laboratory model of the new Westinghouse-developed "mass spectrometer," an adaptation of which analyzes gases with incredible swiftness and accuracy. Right now, one of the most important of its many uses is speeding up tremendously a step in the making of synthetic rubber.

Westinghouse research accepts every wartime challenge . . .

Under the spur of war, Westinghouse research is delving into numberless mysteries, not only in the vast field of electricity and electronics, but also in chemistry, physics, metallurgy, plastics. And as a result, out of the great Westinghouse laboratories has come a steady stream of new war products, and new and better ways of making old ones.

Westinghouse research develops new talent for America . . .

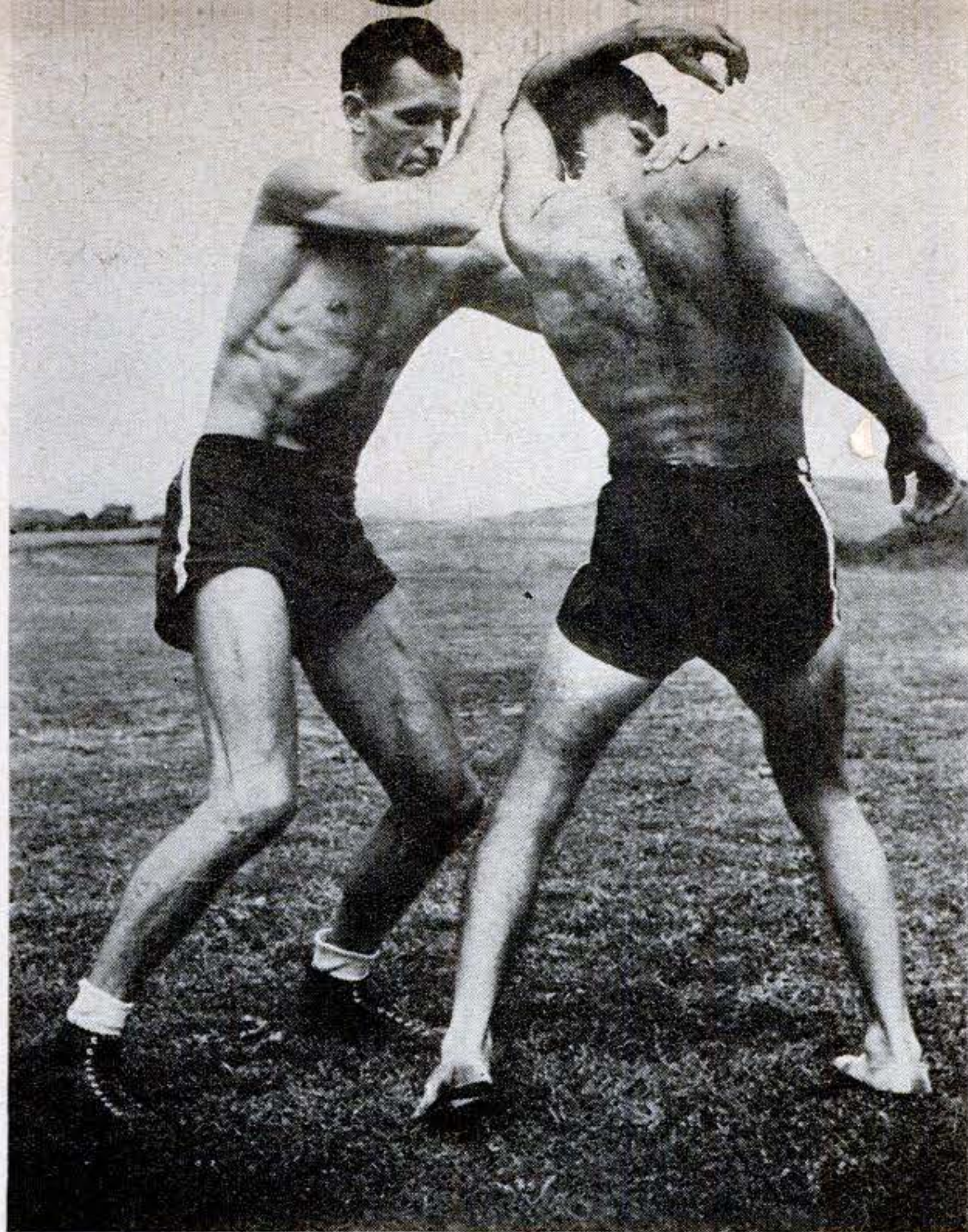
To Westinghouse, each year, come several hundred budding scientists and engineers—to work, to learn, to blaze new trails in electrical research. And each year, through more than 100 Westinghouse scholarships, young men enter America's engineering colleges to develop the native skill and talent that have made America great and will make it greater.



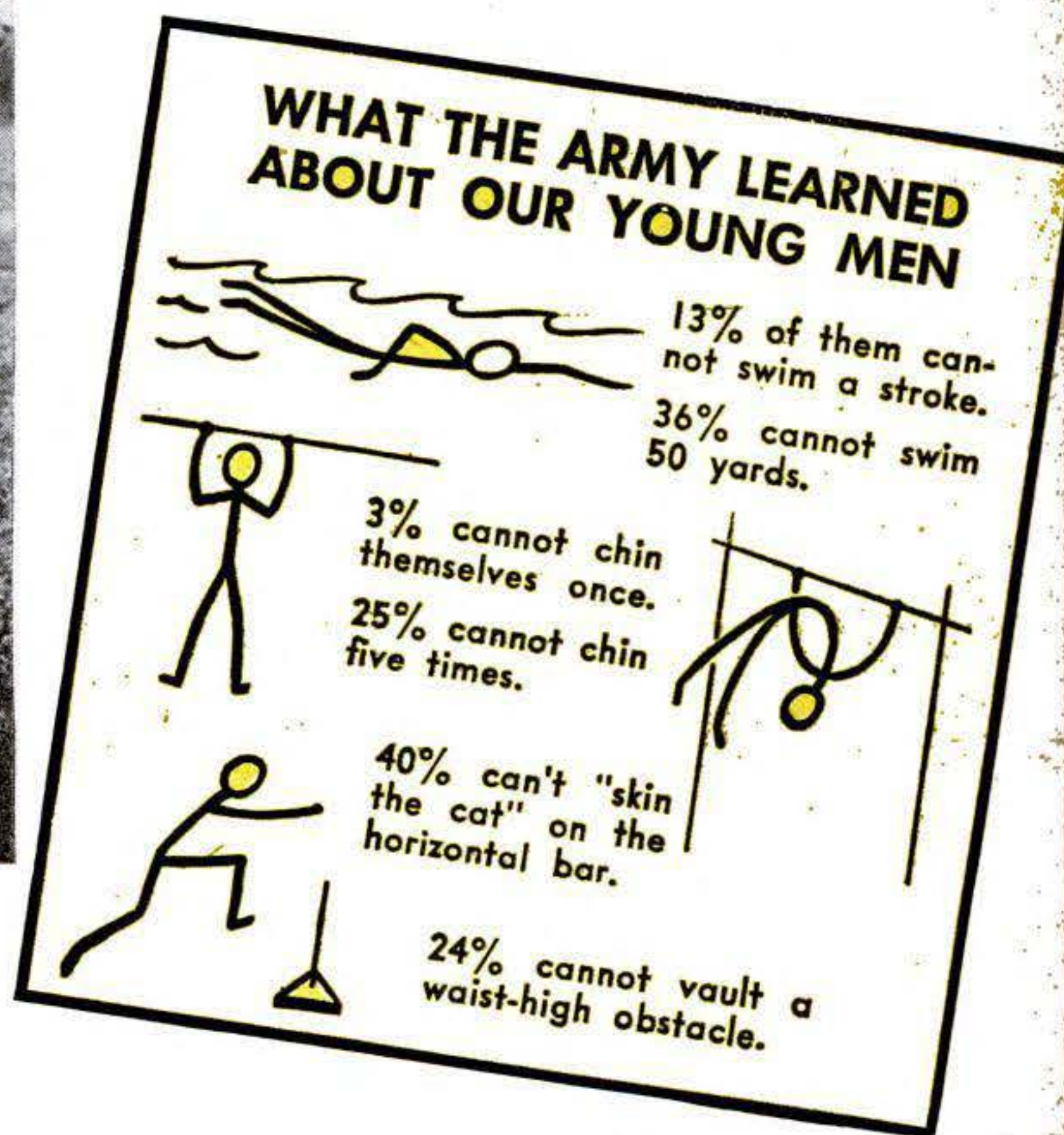
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You have heard much talk of the marvels science will offer you after the War. Well, there *will* be marvels—plenty of them—and Westinghouse research is working to contribute its full share. But we will never lose sight of what we consider our first duty: seeing that, beyond all question, each Westinghouse product, old or new, is the very finest of its kind. Westinghouse Electric & Manufacturing Co., Pittsburgh, Penna. Plants in 25 cities, offices everywhere.





GUERRILLA TACTICS are important to every soldier, who never knows when he may find himself unarmed and face to face with a Nazi or a Jap. The man at far left is executing a quick maneuver that will spin his opponent around so that he can grapple with him from the rear, or trip him and throw him hard to the ground



Can We Make Our Soldiers Tough Enough?

When the Army found that our boys were a bunch of softies, it developed a physical-training program that prepares them in double-quick time for the rough-and-tumble business of war.

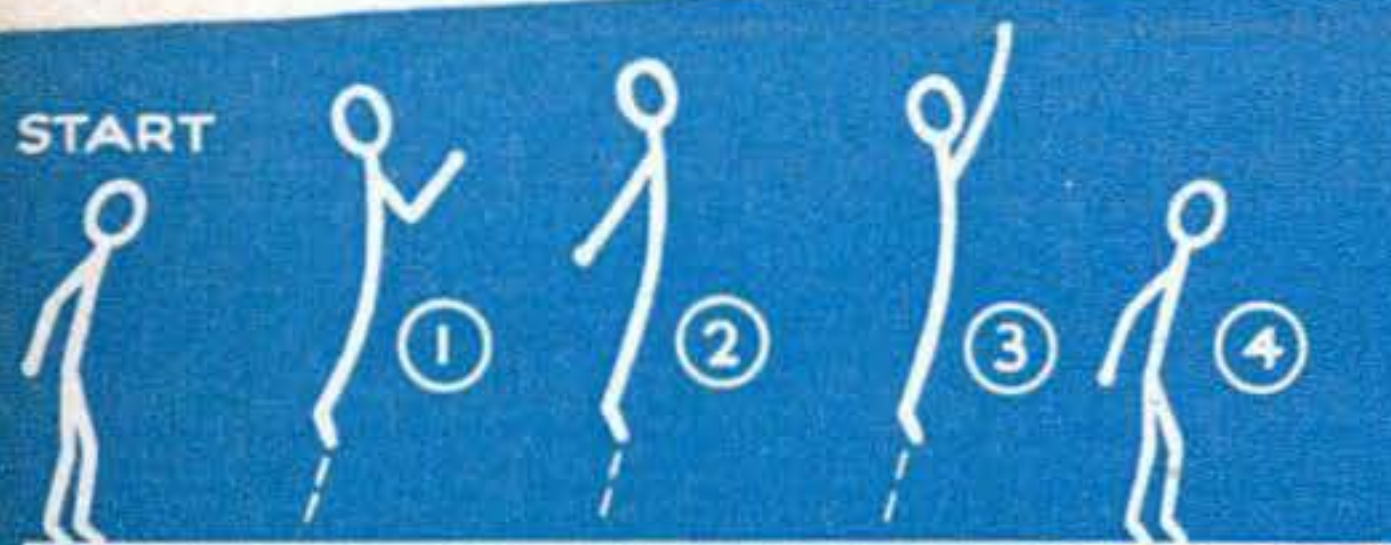
By **ALLEN RAYMOND**

Photographs by **WILLIAM W. MORRIS**

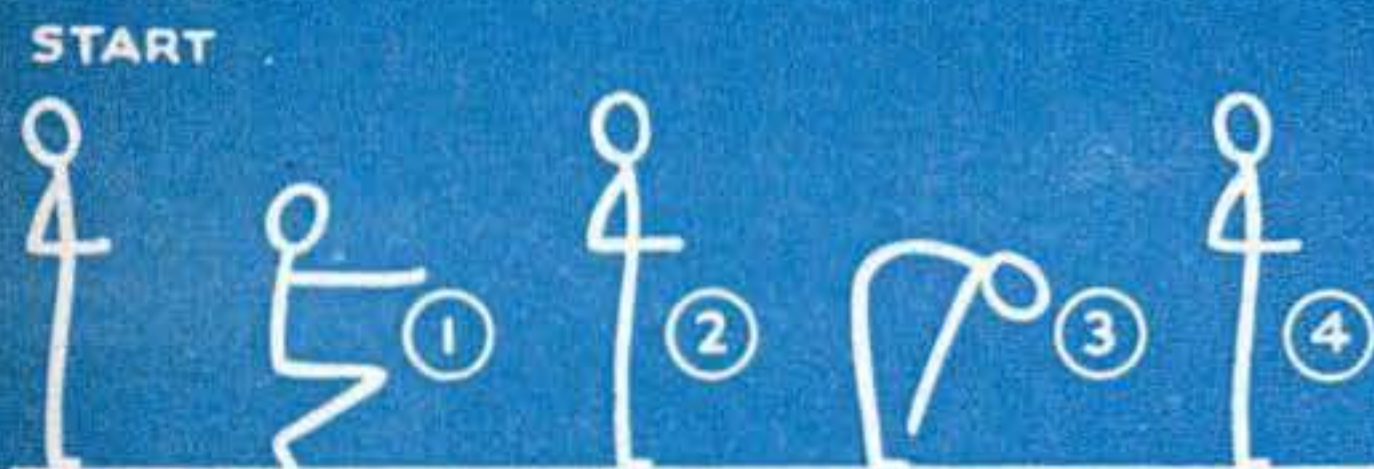
WORLD WAR II demands physical stamina far greater than that possessed by the average American boy. Our young men are a sad commentary on the machine age, easy schooling, and easy living. They're softies, compared with their fathers of a generation ago. They look all right; they're taller, heavier, better nourished, and freer from disease. But they haven't exercised as much as their fathers used to, and they're physical weaklings by present-day military standards.

That's the conviction of the three men largely responsible for the U.S. Army's toughening program. These men, now assigned to the Special Service Forces, are Col. Theodore P. *(Continued on page 60)*

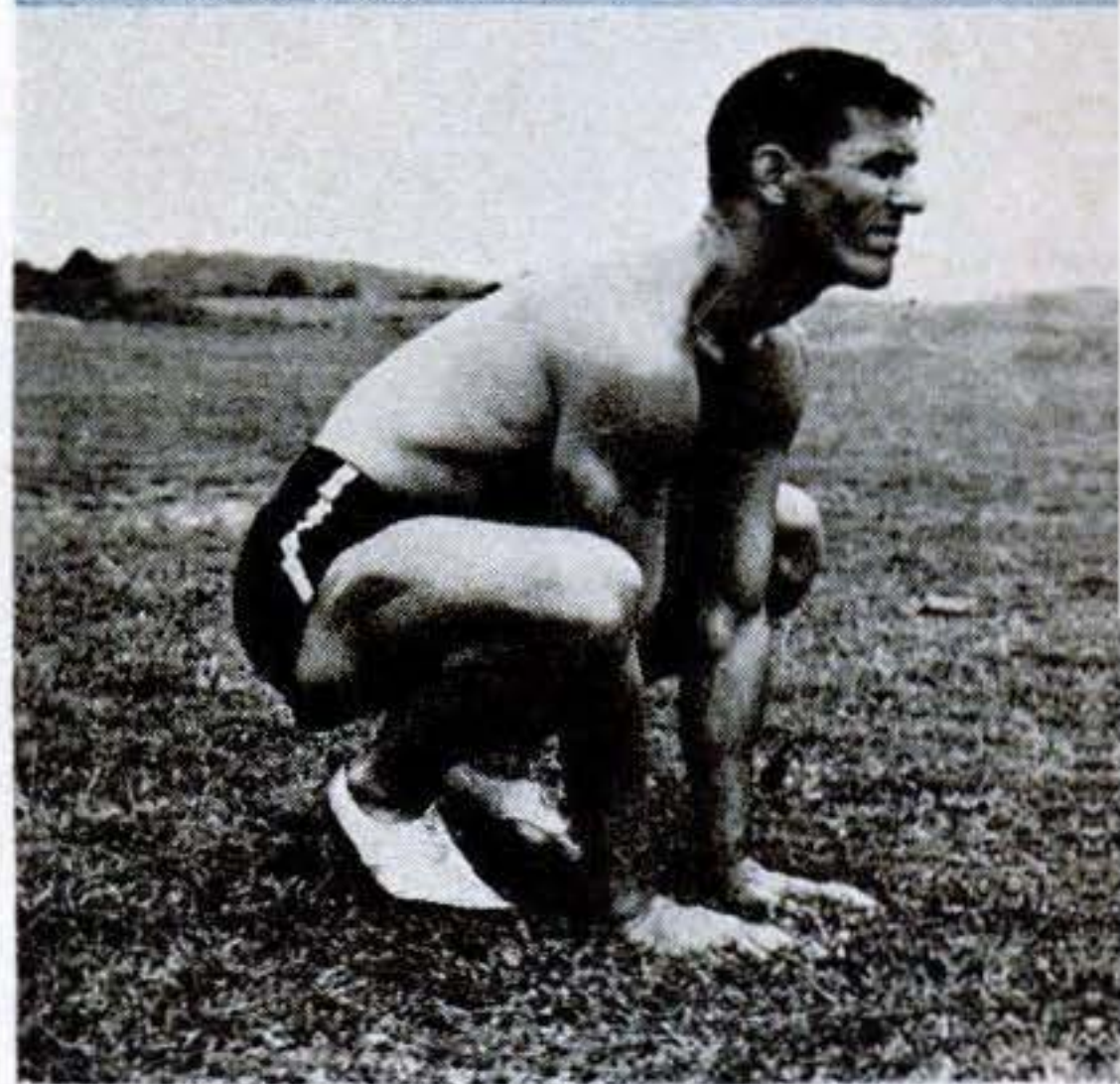
The Army's Daily Dozen



THE HIGH JUMPER



SQUAT BENDER



THE BURPEE is done in four counts. A man first assumes a standing position, with arms at his sides, and feet a couple of inches apart. At the count of "one," he goes down to a squatting position, with hands flat on the ground, and arms inside his knees. At "two," he throws



ROWING EXERCISE

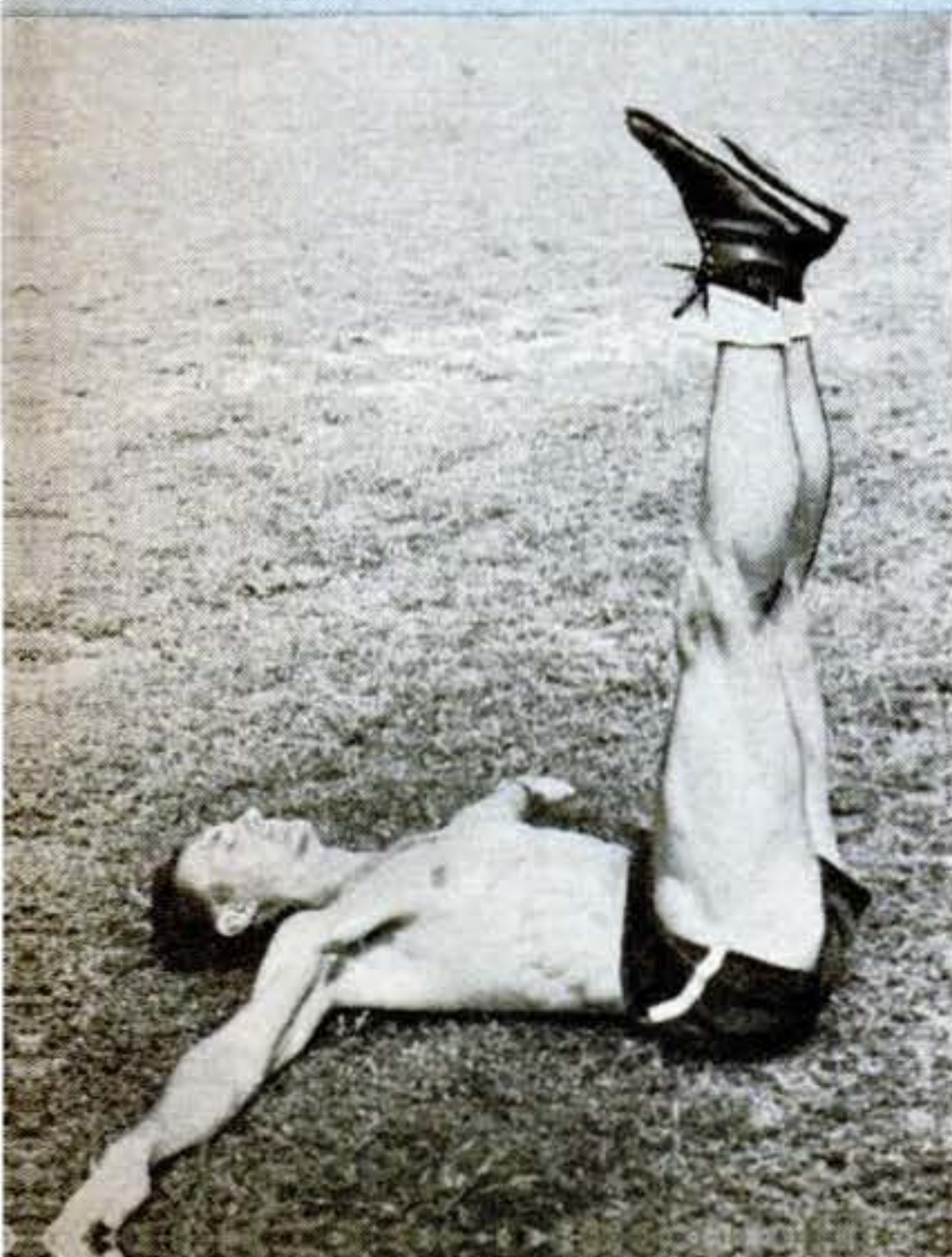


SIT-UPS

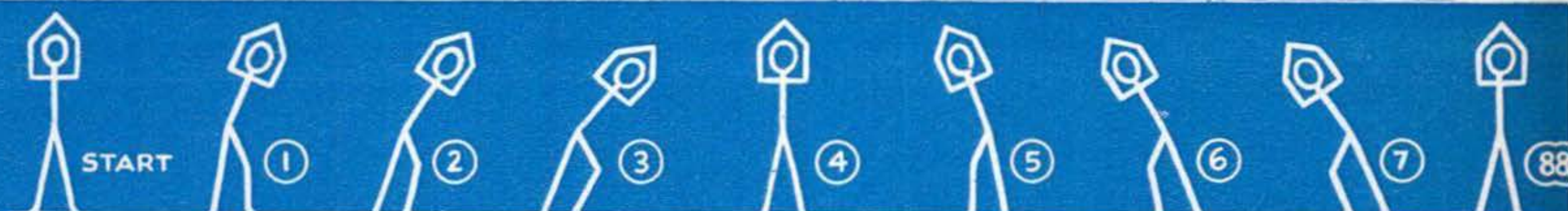
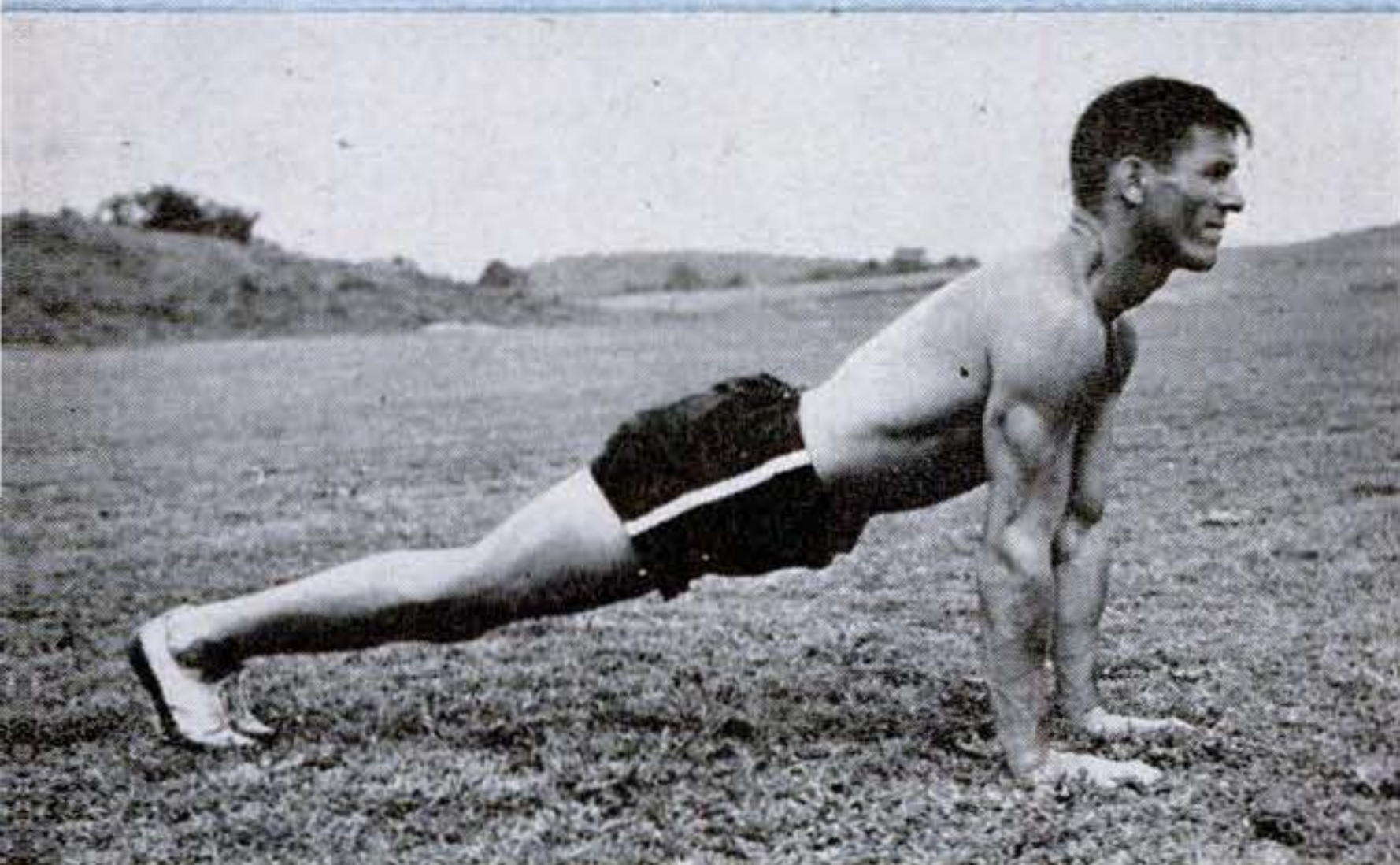


PUSH-UPS

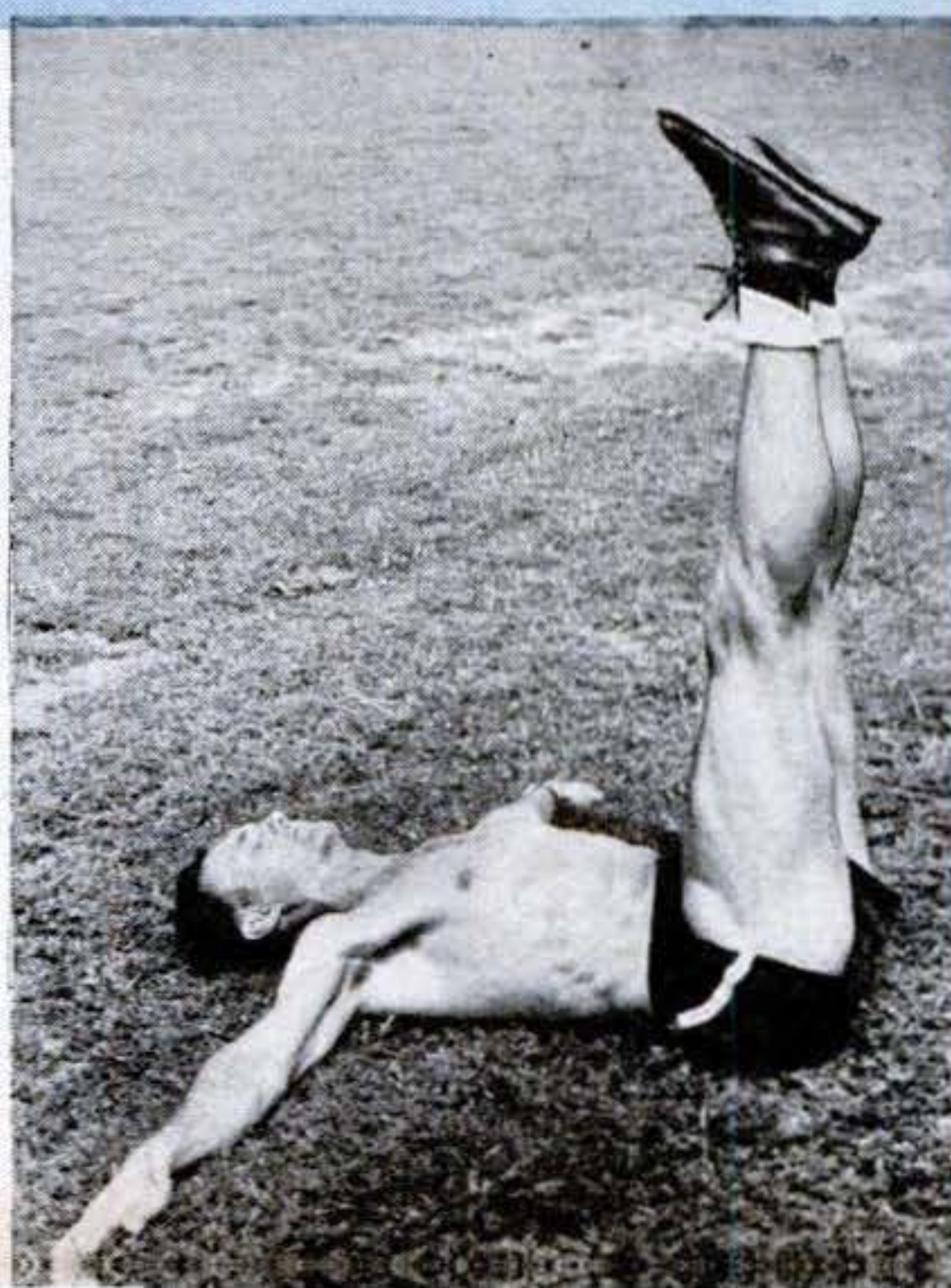
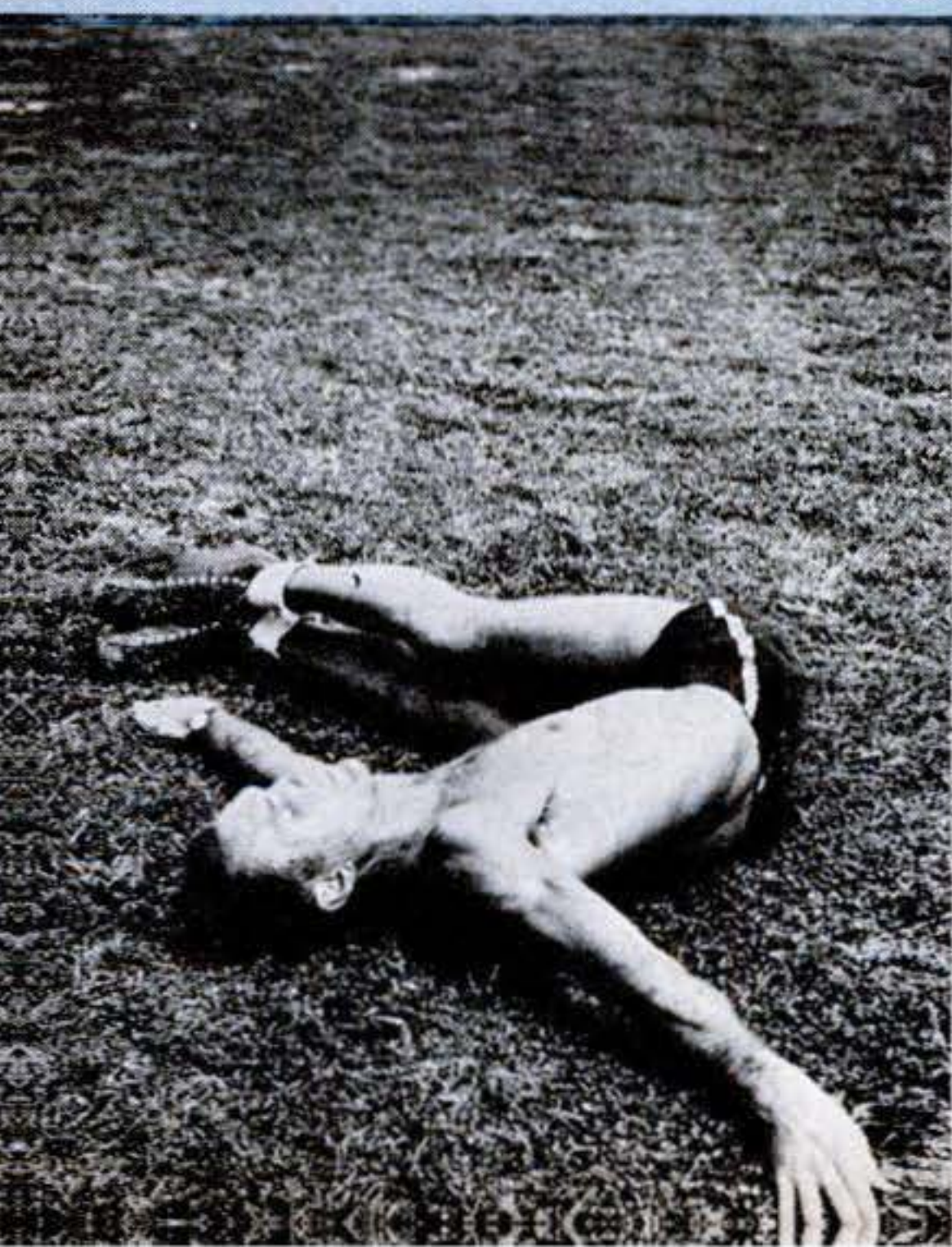
THE BANK TWIST, named after Col. T. P. Bank, one of the three men largely responsible for developing the new physical-conditioning program, is a real "toughy." A man lies on his back with his legs held up in front of him so that they form a 90-degree angle with his torso. His legs are together, and held straight so that there is no bend in the knees. His arms are extended at his sides, palms down. At the count of "one," he lowers his



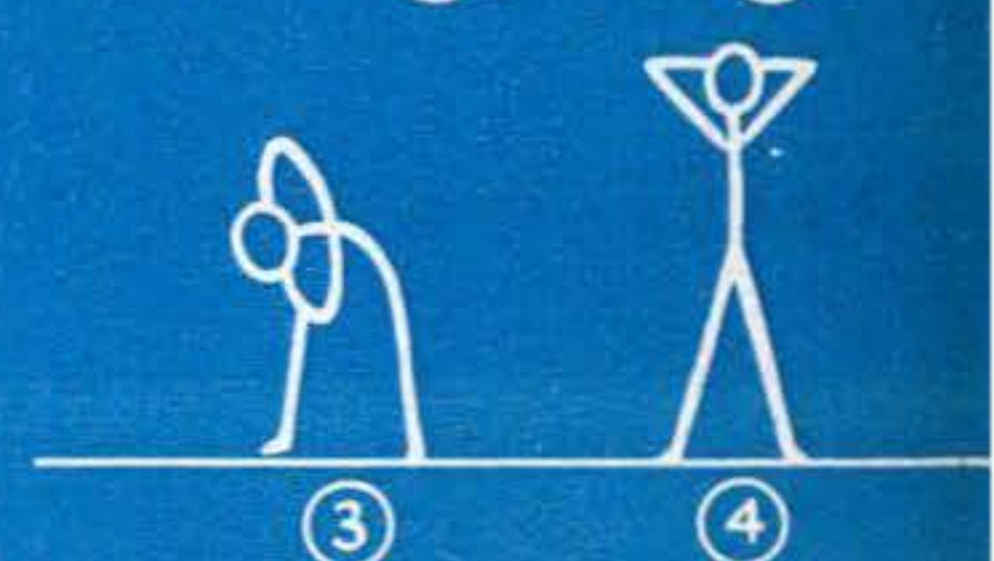
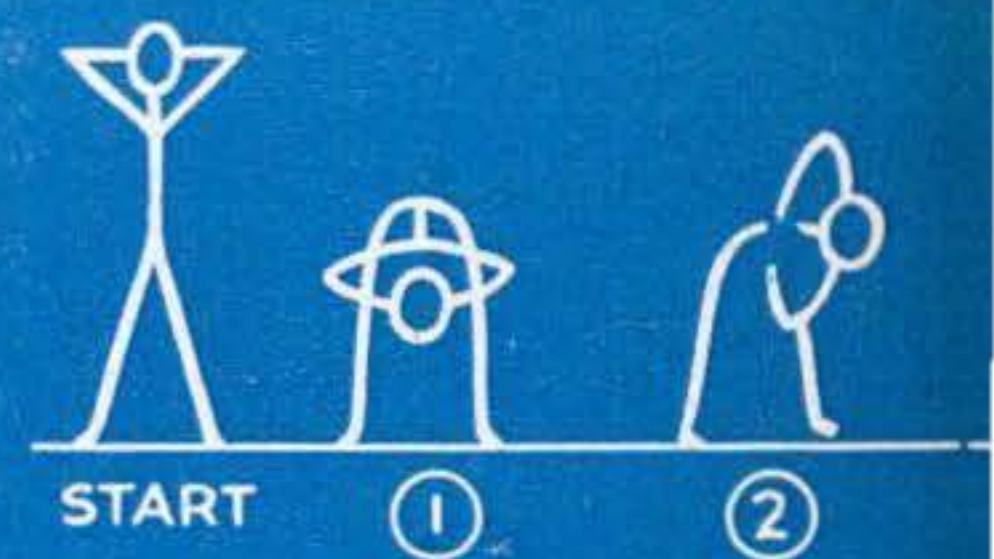
his weight is resting on his hands and toes. At "three," he jumps back to squatting position, and at "four" he stands up. The burpee is one of the seven exercises now being used to test a soldier's physical fitness as well as his improvement under the new toughening-up program. Even the rawest recruit can do this exercise a few times—slowly. But the Army doesn't consider him fit for the rigors of war until he can do it 40 or 50 times, in easy rhythm, without pausing for rest. In testing men with this exercise, the Army considers that eight burpees done in 20 seconds is poor; 10 burpees is fair; 12 is good; and 13 or better is excellent



legs, still held straight, to the ground so that his feet are in the vicinity of his right hand. At "two," he brings his legs back to the erect position. At "three," he lowers his legs to the ground at his left, and then comes up again on "four." Thirty of these twists done fast is considered only average



STATIONARY RUN



TRUNK TWISTER

WEAK HORSE is one of the Army's toughening-up games. One team lines up, as shown, against "base" at right. Each member of "up" team then takes a flying leap and lands on the backs and necks of "down" team in effort to snap "horsey's" back. Below, a page from the games manual now being issued by Special Service



S. BEATER GOES ROUND



Players: Any number.
 Equipment: Belt or taped cloth that can be used as a beater.
 Area: Any area.
 The Game: All players, except one, form a circle, facing counter clockwise, with their hands behind their backs, heads and eyes to the front. The extra player is given the beater and walking around the circle clockwise, places the beater in the hand of another player. The player receiving the beater swats the player ahead of him and chases him around the circle, beating him as often as possible until he gets back to his starting place. The player holding the beater then gives it to someone else. When the extra player hands the beater to another player, he steps into the place vacated. This game can be varied by having the players form a circle, face the center, and close their eyes. They keep their hands behind them. In this variation, the player receiving the beater swats the player to his right.

Bank, formerly athletic coach at Tulane and Idaho universities; Capt. A. A. Eslinger, director of physical education at Leland Stanford University, and C. H. McCloy, director of physical education at the University of Iowa. Much of the new training system was worked out by this trio just before Pearl Harbor.

At the school in Washington and Lee University, Lexington, Va., where Special Service officers are trained in the new hardening program, Captain Eslinger gave me some data on the physical unfitness of average American college boys, as of 1940 and 1941.

"In a physical-fitness test of 1,000 men at the University of Illinois in 1940," he said, "the following facts were revealed: 13 percent of them couldn't swim a stroke and 36 percent couldn't swim 50 yards. Over three percent couldn't chin themselves even

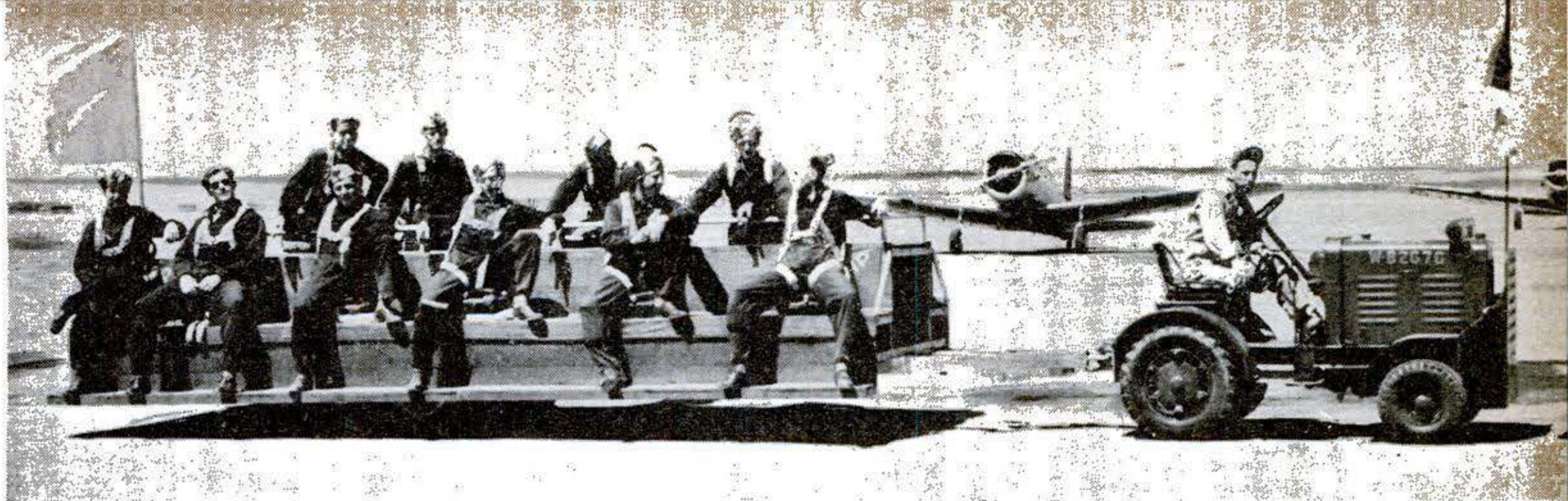
once, and more than 25 percent couldn't chin themselves five times. About 24 percent couldn't vault an obstacle waist high; more than 40 percent couldn't 'skin the cat,' an easy stunt for their fathers."

Captain Eslinger had examples—taken from battle reports—to illustrate how disastrous it may be to a soldier in wartime to lack strength in his arms and shoulders. "The crew of an American bomber," he said, "made a forced landing at sea off the Aleutians. A small naval vessel sped to their rescue. With high seas running, ropes were lowered to the airmen floating aboard their collapsible raft. All but one were saved. That man couldn't climb the rope."

A similar fatality occurred, he said, aboard a U.S. Army transport sunk offshore in operations near Guadalcanal. An enlisted man was caught below decks with no means of escape except through a hatchway only 20 feet above his head. A comrade tossed him a rope. But the man was unable to climb it, and his comrade was unable to pull him up.

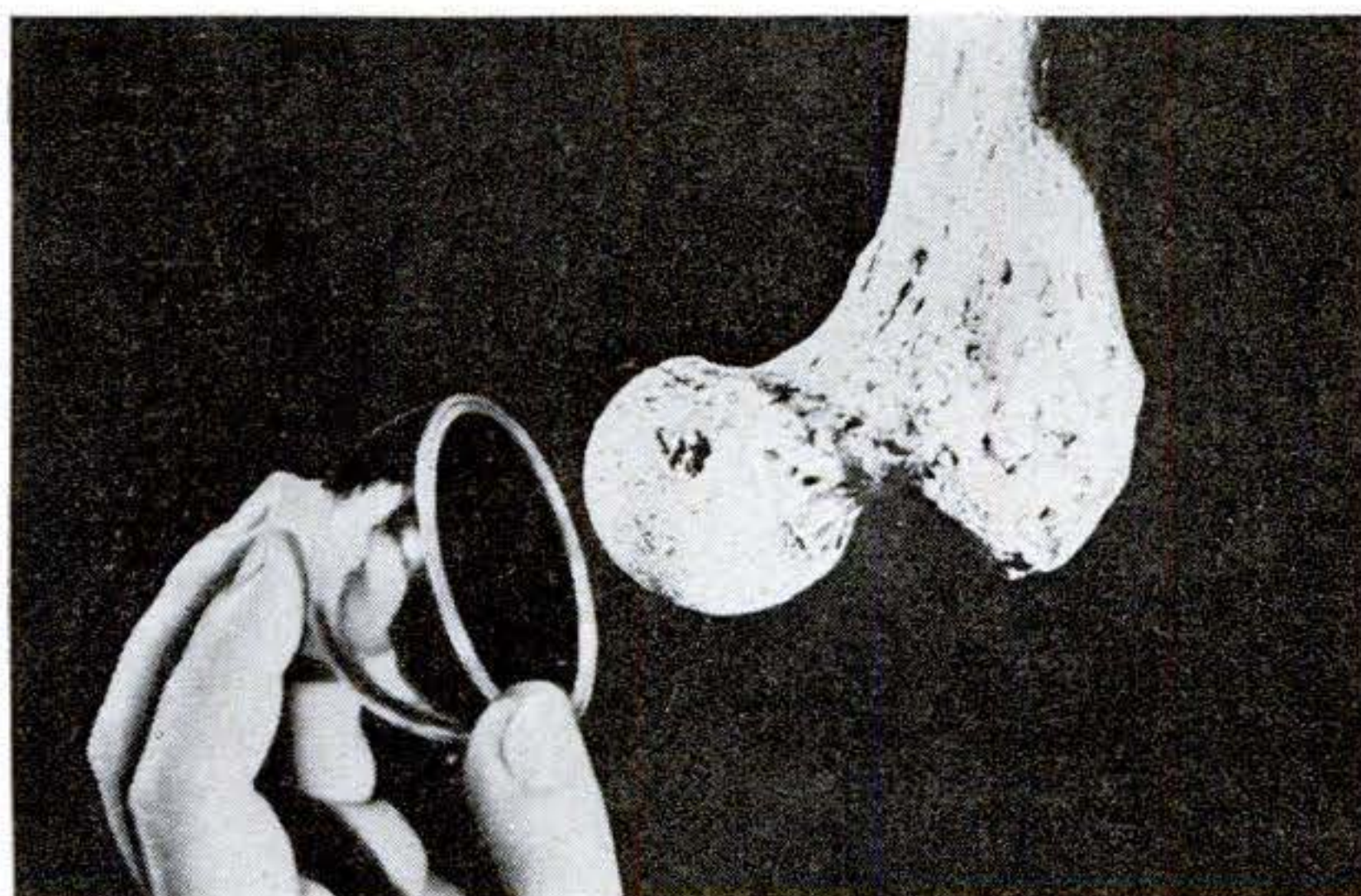
As for strength and agility needed in hand-to-hand combat against such toughened troops as the Nazis, no powers are too great. It was with such situations in mind that the three university athletic directors went over scores of standard drills in calisthenics to develop the single set of 12 that is now working miracles for the Army. They packed into a dozen basic exercises, which can be run through in 20 minutes, more strenuous physical drill than was contained in the 60-minute system used before the war. Then they added "guerrilla" exercises and combative drills, and topped their new system with rough-and-tumble games to built competitive spirit among our troops.

Under the new program, recently compiled in a manual known as Training Circular 87, every soldier in our Army must be tested individually (*Continued on page 203*)



THE "DRIP," designed and named by Col. K. C. McGregor, is used by the Army Air Forces Western Flying Training Command to taxi flyers and their equipment to and

from their planes at the Basic Training School at Gardner Field, Taft, Calif. Looking like a movable "bleacher section," it is drawn by a "tug" and holds 30 men.



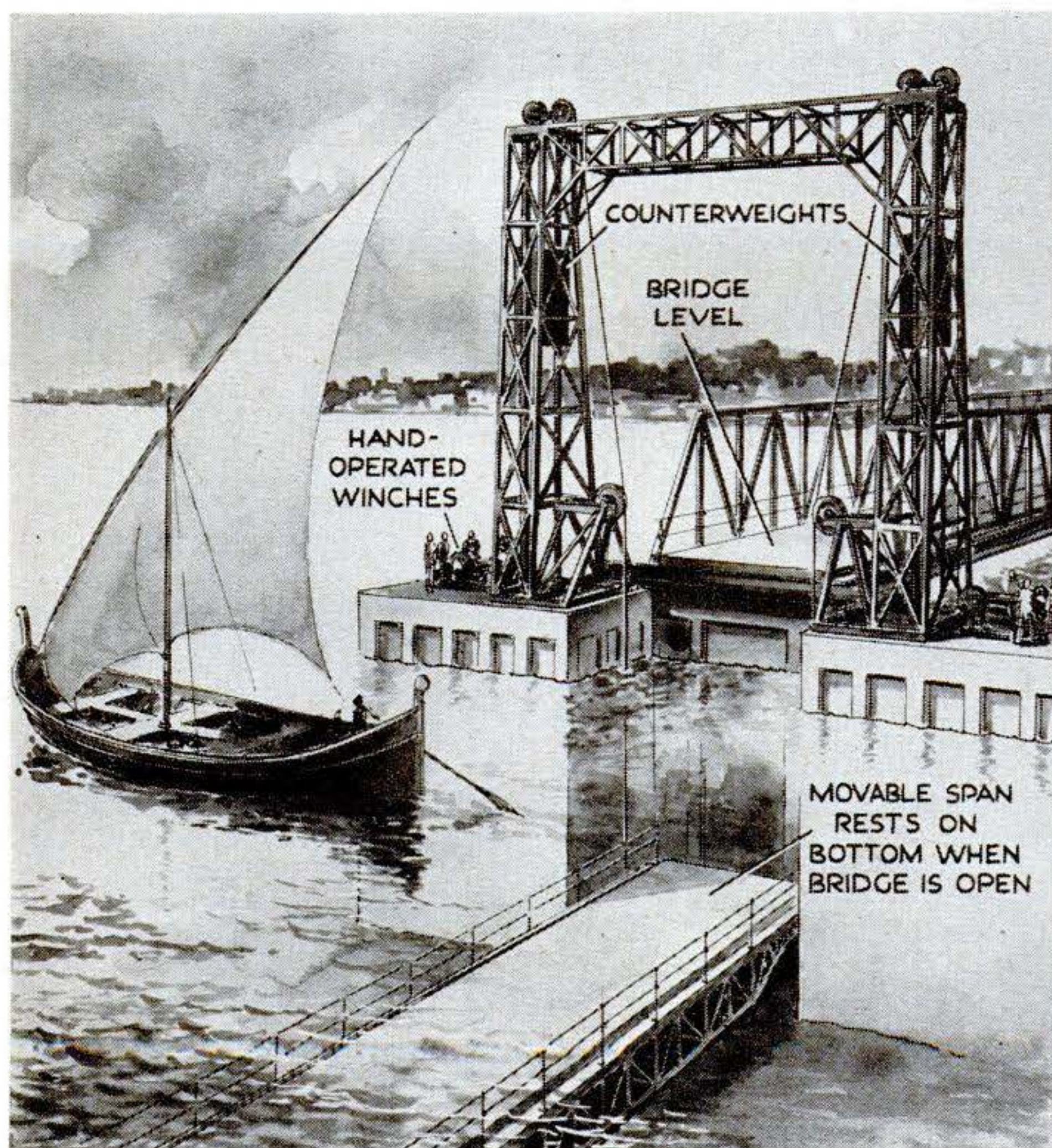
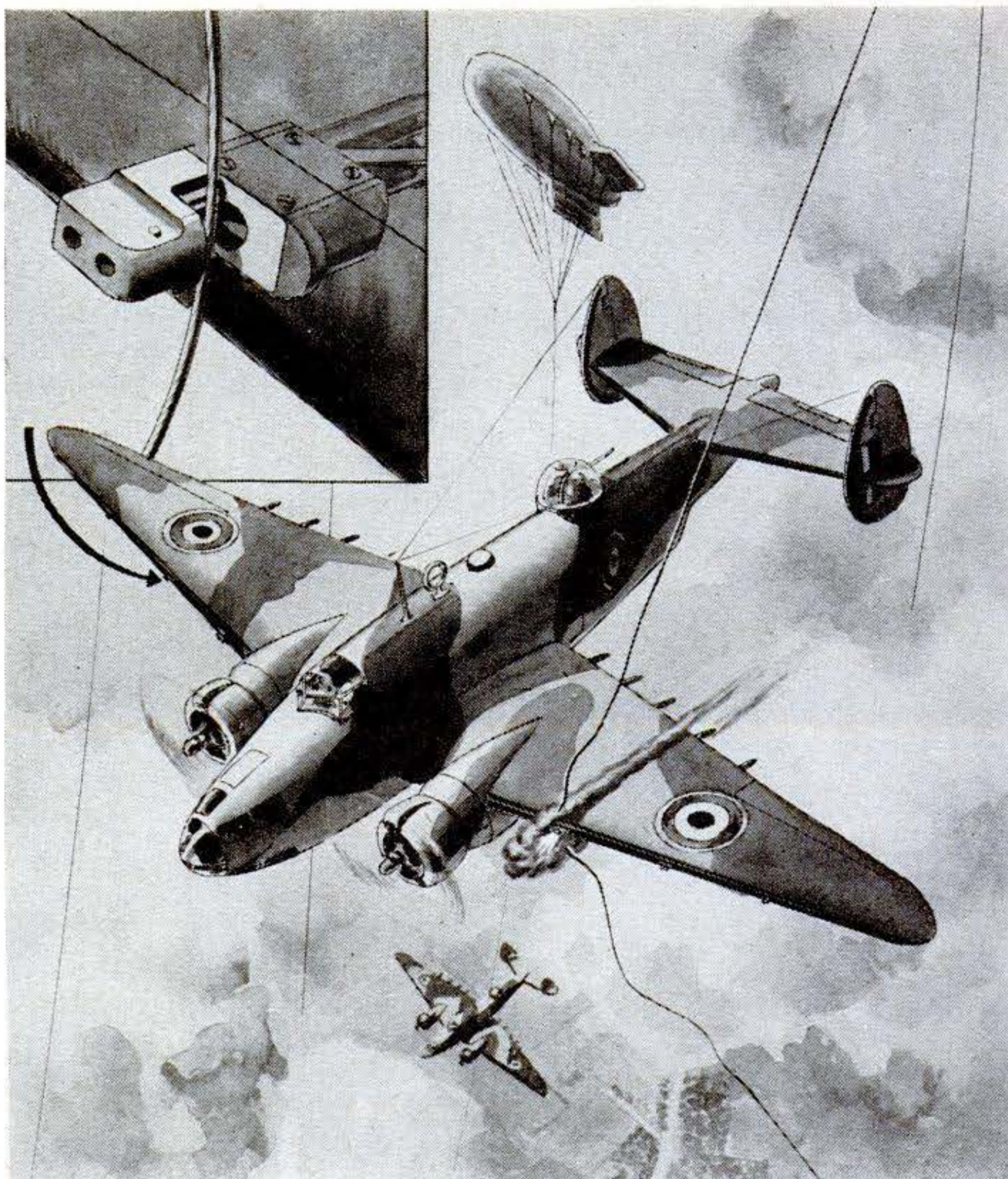
PLEXIGLAS CUPS, formed of the same material that is employed to make bomber noses and gun turrets, are being used to restore painless motion in arthritic joints. Besides affording a smooth surface against which the other bones of the joint can move, the transparent plastic cups facilitate subsequent X-ray examination of the bone head from which excess growth—the cause of arthritic pain—has been removed. The cups, successfully used in finger, jaw, and hip joints, were developed by Dr. Paul H. Harmon, surgeon at the Robert Packer Hospital, Sayre, Pa.

HOBBY CLUBS, tentatively organized by Capt. Wayne E. Scriviner as morale builders for the men at the U. S. A. A. F. Flying Training Command's Basic Training School at Cochran, Ga., are paying double dividends. Over 200 men quickly responded to the Captain's invitation to get together in photography, woodworking, art, printing, and radio and model-plane building, and the products of their work are now being used by the rest of the camp. The radio club (right) now services all the sets on the post; the model-building club (lower right) provides a place for aircraft-construction experiments; the woodworkers build chairs, tables, and bookshelves for the recreation rooms, and the camp's artists (below) knock out war-bond posters.



CABLE CUTTERS. Automatic devices set at intervals along the leading wing edges of Britain's bombers (see inset) are enabling the planes to cut their way through the barrage-balloon cables that the Germans are employing as protection against low-level attacks. When one of the cutters is hit by a cable, the contact sets off an explosive charge. This drives home a chisel that snips the cable. Metal reinforcements protect the wings as the cables slide along the leading edges to enter the aperture of a cutter. The drawing at the right depicts an American-built Ventura, a medium bomber used by the British, equipped with the new device and slicing a path through a screen of German cables. Extending from the trailing edges are the ends of the tracks upon which the Fowler flaps are extended to reduce the speed of the plane in landing.

Drawings by B. G. SEIELSTAD



VANISHING BRIDGE. Believed to be the only one of its kind is the Shatt-el-Arab River bridge in Iraq, whose center span sinks into the river low enough for water traffic to pass over it. This unusual design was decided upon by an Indian Army engineer as the best method of eliminating the high towers required by a lift bridge, which would have been constantly threatened by the monsoon gales. The bridge carries both rail and road traffic across the stream, which is formed by the confluence of the Tigris and Euphrates rivers. Its 92-foot center span, which weighs about 35 tons, is raised and lowered by hand-operated winches. At the left is our artist's conception of how the bridge appears with the center span lowered. The span can be dropped enough to be cleared by the deepest-draft boats on the river.

Take it from a Yankee pilot...

Burma Is No Paradise

An Interview with

COL. ROBERT L. SCOTT, Jr.,

Author of "God Is My Co-Pilot"

By Robert E. Martin

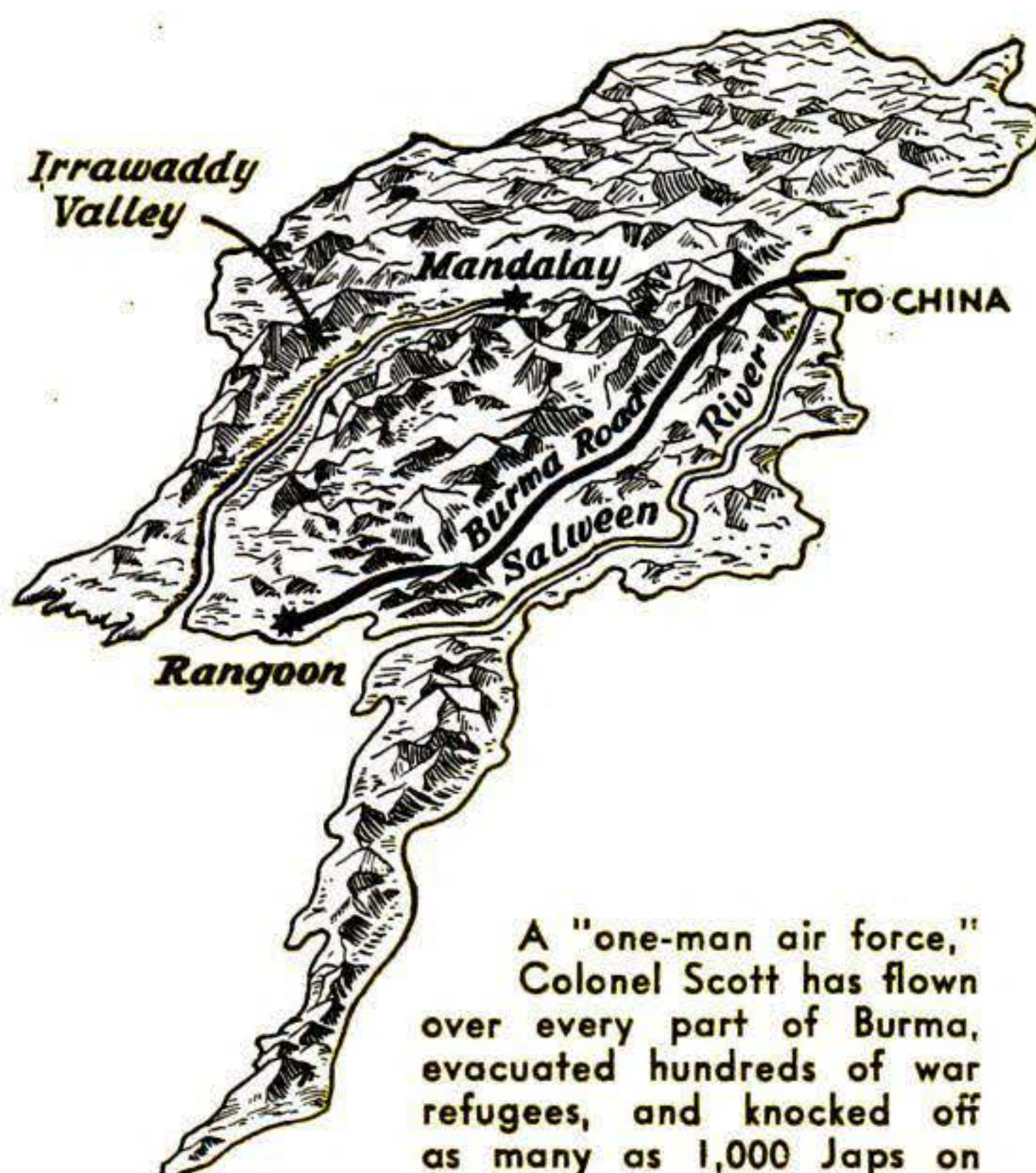
BURMA once again may become a battleground of this war. Already it has been the scene of a great campaign, where American, British, and Chinese alike faced hardships and privations beyond what they had to endure from the Japs. Among the Allied fighters was Col. Robert L. Scott, Jr., former Fighter Commander of the China Air Task Force under General Chennault. Because he knows Burma, and neighboring China, as few soldiers do, Colonel Scott has much to tell of the grim business of survival in a land once considered plentiful.

"Before the war, Burma was an enormous rice bowl," said Colonel Scott, "and yet, during May and June of 1942, the Ferry Command dropped 2,000,000 pounds of rice in the northern part of the country to keep two Chinese armies from starving to death. More rice was grown in the Irrawaddy Valley than in any other section of the world, but the Burmese weren't furnishing any food for the Allies.

"As we dropped the rice from about 50 feet, I could see cattle wandering through the streets of villages and out in the fields. I said to myself, 'What the hell is this, anyway? How in the world can those men be starving, with all that food on the hoof available?' So I landed on a little 800-foot airfield to have a look. Then, protected by four sergeants with Tommy guns—not knowing what to expect—I walked down the road and saw plenty of dead men, mostly cholera victims."

The first chance he got, Colonel Scott queried General Ho, who, you remember, commanded those Chinese troops who had come down the Burma Road to support the Allies. Why hadn't he slaughtered the cattle to feed his men?

Jungles, hostile natives, and disease make Kipling's "Road to Mandalay" rough going for both flyers and land fighters.



A "one-man air force," Colonel Scott has flown over every part of Burma, evacuated hundreds of war refugees, and knocked off as many as 1,000 Japs on a single strafing mission



General Ho, who viewed the situation through the eyes of an Oriental, explained that cattle were sacred in Buddhist Burma, and not a single bullock could be killed, though the people starved by the thousands. Therefore, the only source of food for the Chinese was that which the Ferry Command was able to carry in to them.

"But dropping food, even from a height of only 50 or 60 feet, presents a serious problem," the Colonel went on. "First we dropped 50-pound burlap bags of rice, rock salt, and dried fish. But when the bags struck the ground they immediately burst open, scattering the food in every direction. So we conceived the idea of placing 50-pound parcels of food in burlap bags, each capable of holding 100 pounds. Then we put those bags in others of equal size. On landing, the inner bag burst, but not the outer one.

"We also dropped wooden boxes of ammunition, which we thought was all right because the boxes didn't break. But the impact flattened out the shells so that they couldn't be used. The only way to drop ammunition is with parachutes. Dropping food and ammunition to beleaguered troops

is often vital, but you have to know how to do it. Living and fighting in China and Burma constantly present problems for which there are no answers in the books."

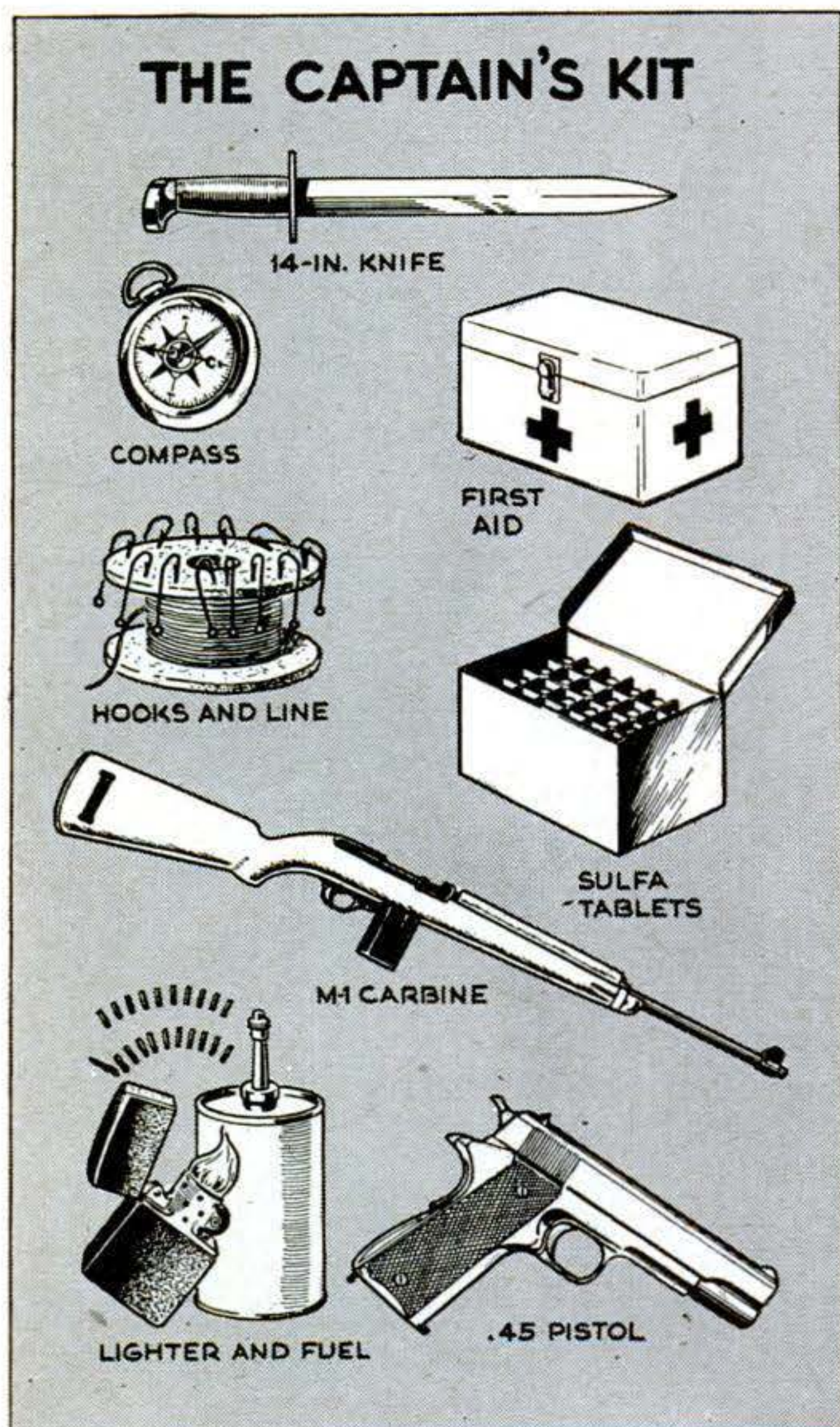
Burma, once known romantically to Americans from Kipling's "Road to Mandalay," is a country of alternating plenty and starvation, distrust and hatred of the white man, disease and superstition, high mountains, thick jungles, and rivers—which, in the rainy seasons, rise suddenly and flood the valleys.

"In China," the Colonel went on, "the people would give you their last grain of rice if you needed it, but in Burma they would plot to kill you while you were a guest in their villages. Waging war in a hostile, disease-ridden land, against an unscrupulous enemy, with your lines of communication from the United States 10,000 miles long, is an enormous problem. But for the individual flyer, the problem is far worse if he has the misfortune to be forced down. He has to face native hostility, religious prejudices, and epidemic disease. Besides, in the jungles of northern Burma in particular, there is very little in the way of food or game on which to live. From the standpoint of survival, it is perhaps the most difficult land in the world."

Colonel Scott knows whereof he speaks, because he has flown over every part of Burma and come in contact with all kinds of people while transporting starving, sick, and wounded refugees by the hundreds from Burma to India. He has been called "the one-man air force," having disposed of from 600 to 1,000 Japs during one strafing mission on a group of Japanese barges and accounted for as many more in shooting up a train in upper Burma. These are but two of many single-handed exploits.

The Colonel, however, is considerably more than a soldier and flyer whose work in China has established his reputation. He has, in addition, a scientific turn of mind, and his observations on geography, climatology, Burmese ethnology (the study of the characteristics of the people), zoology, and botany are worth listening to. All these subjects and more are discussed in Colonel Scott's book, "God Is My Co-Pilot," published by Scribners and now being made into a movie by Warner Brothers.

"I have survived for weeks at a time," the Colonel continued, "in the jungles of South America and among the head-hunters in the forests of Darien, without any serious trouble. I have made my own fire, boy-scout fashion, and cooked my own meals as I found edible plants and game. In fact, no training that I have had in the past has helped me more than having been a boy scout, in making my way alone and living



Burma Album

Like a conquering hero, a wounded American flyer lucky enough to be forced down among friendly natives is carried back to safety on the shoulders of his rescuers. Burma's head-hunters, however, have to be given a bounty of \$30 for every American rescued with head intact



Under the watchful eye of a Negro sergeant of the U. S. Army Engineers, Chinese coolies work on a new road to link Assam with the original Burma Road. Completion of the new highway will aid forthcoming Allied offensives



Disease is rampant among the vitamin-starved natives of Burma, where a fungus growth may eat a hole in a man's leg the size of a baseball. Above, an American-trained native nurse treats a Burmese who wears the traditional head-hunter's hat

American jeeps and trucks slog their way over the Assam-Burma Road link hacked out of the jungle by U. S. Army Engineers. Annual rainfall of 500 inches will keep the trucks wallowing in mud



off the land. But in Burma, from Lashio northward, the country is almost a trackless jungle to the tops of mountains which average about 13,000 feet, with some peaks running as high as 20,000 feet. These are tough mountains to fly over, but far, far tougher to traverse on foot."

Jungles generally, Colonel Scott was reminded, offer as much or more natural food than do forests back home. He agreed, but added with emphasis, "Not in certain sections of Burma! Such easily gathered foods as breadfruit, durian, pandanus, or palms are too scarce there to do much good." Palms, in particular, with their long, pointed buds in the center of terminal crowns of leaves, seemed to go with the jungles. It is hard to imagine a jungle without them. "Oh, yes," answered the Colonel, "there are some palms, but few of the edible varieties. I've often eaten palm 'cabbages,' both raw and cooked, and they're usually good either way. I've eaten them whenever I could find them, because of their high vitamin content. And in Burma, more than in any other part of the world that I know of, the lack of vitamins—or avitaminosis, as the doctors call it—is serious. I've seen men with holes in their legs large enough to hold a baseball—no, they weren't wounds; it was a kind of tissue deterioration which came from mosquito bites in which a fungus growth had developed. The fungus kept eating the opening larger and larger. But the fundamental cause was the fact that the men thus afflicted were in a run-down condition owing to lack of vitamins. No, in the Burmese jungles you're lucky to find a few berries and ferns to live on."

But how about game? "Very little. Some birds, of course, but often you're wasting ammunition trying to shoot a bird in the jungle. If you can't see where the bird is going to fall, it'll be difficult to find it even if it drops only a few feet away. And a .45 was never designed for shooting either birds or animals. The scarcity of animals in the mountains south of the Chinese border is due, we supposed—at least in part—to the terrific rainfall. There aren't many places in the world where it rains harder than in Burma during the monsoons! As much as 500 inches a year falls in certain parts of the country, and that's a lot of water! You see, the mountain ranges, which are really the foothills of the Himalayas—if you can call mountains from 12,000 feet to 20,000 feet foothills—run generally north and south, all the way from the Salween River to the Naga Hills, which divide India from Burma. Between these ranges run swift rivers, in deep gorges. In the rainy season these rivers often rise as much as 50 feet in a single night! Such streams

limit the movement of wildlife and must wipe out large numbers of animals. So it's not inconceivable that the terrific rains have had much to do with making game so scarce. There probably are other reasons, too, but whatever they are, I know that there is practically no edible game. This is not true of the Naga Hills farther to the north, where there is a good deal of big game.

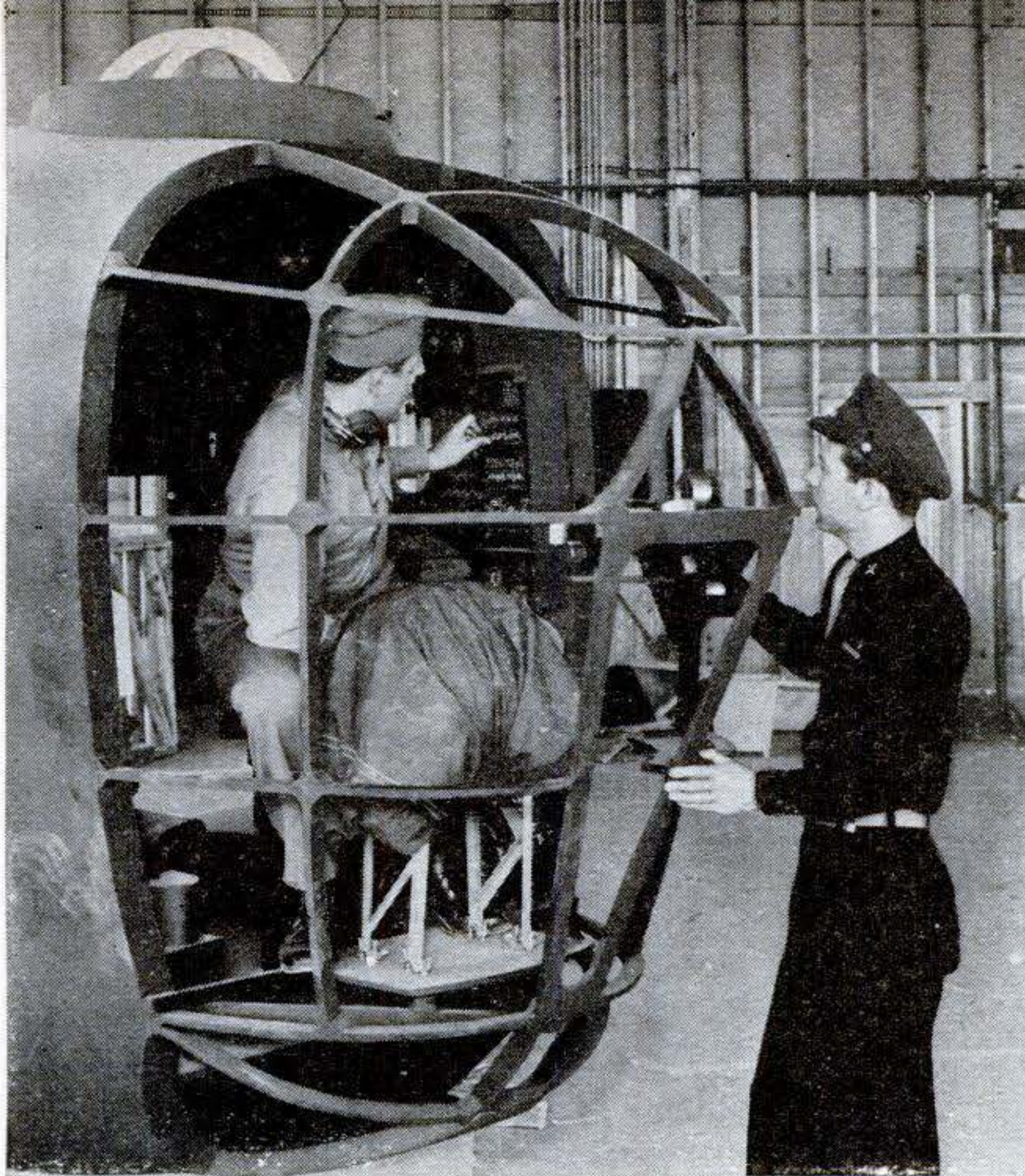
"In the south, of course, there is ample food. As I said before, Burma was the 'rice bowl of Asia,' but where there's rice there are people—many of them—and most of them hostile, so that you're worse off there than in the barren jungles of the north. On the other hand, if you're forced down in New Guinea or the Solomons, where the natives generally hate the Japs and—thanks to the missionaries—have a high regard for the white man, you will be fed and led to safety. But many of the Burmese will stab you in the back or hand you over to the Japs.

"The greatest enemy, however, is malaria. I've been through villages where 95 percent of the people were sick with that disease. The ordinary malaria that we know about here is bad enough, but the malignant, cerebral variety in Burma is really tough. Often it seems that neither atabrine nor quinine helps very much, but still they're the best drugs known for it.

"Your best bet is to take every precaution to keep from getting malaria. Never go without your shirt, however hot it is, and keep your sleeves rolled down; wear gloves when possible, and tie a piece of string or plant fiber around your sleeves at the wrists. Keep your trousers tucked in your G.I. shoes and never, under any circumstances, be without a mosquito head net. I'd go without food if I had to make a choice between food and mosquito netting when I made up my pack of things to carry into Burma. In fact, I'd take a mosquito net if I had to carry it in my mouth. It's that important.

"Frequently at sundown, standing on some rising ground, I noticed a haze in the valleys which at first I thought was a ground fog. The superstitious Burmese would say, pointing to it, 'Look, the Curse.' And indeed it was, but not as they supposed it. That miasmatic haze consisted of myriads of the Anopheles, or malaria-bearing, mosquitoes, which swarm at sundown and are particularly obnoxious for three or four hours thereafter. Don't say, 'Oh, mosquitoes never bother me.' These mosquitoes are hungry—and aren't particular!"

Capt. George W. Shoenfelt, of the Ferry Command, who had flown with the Colonel over the Orient (*Continued on page 218*)

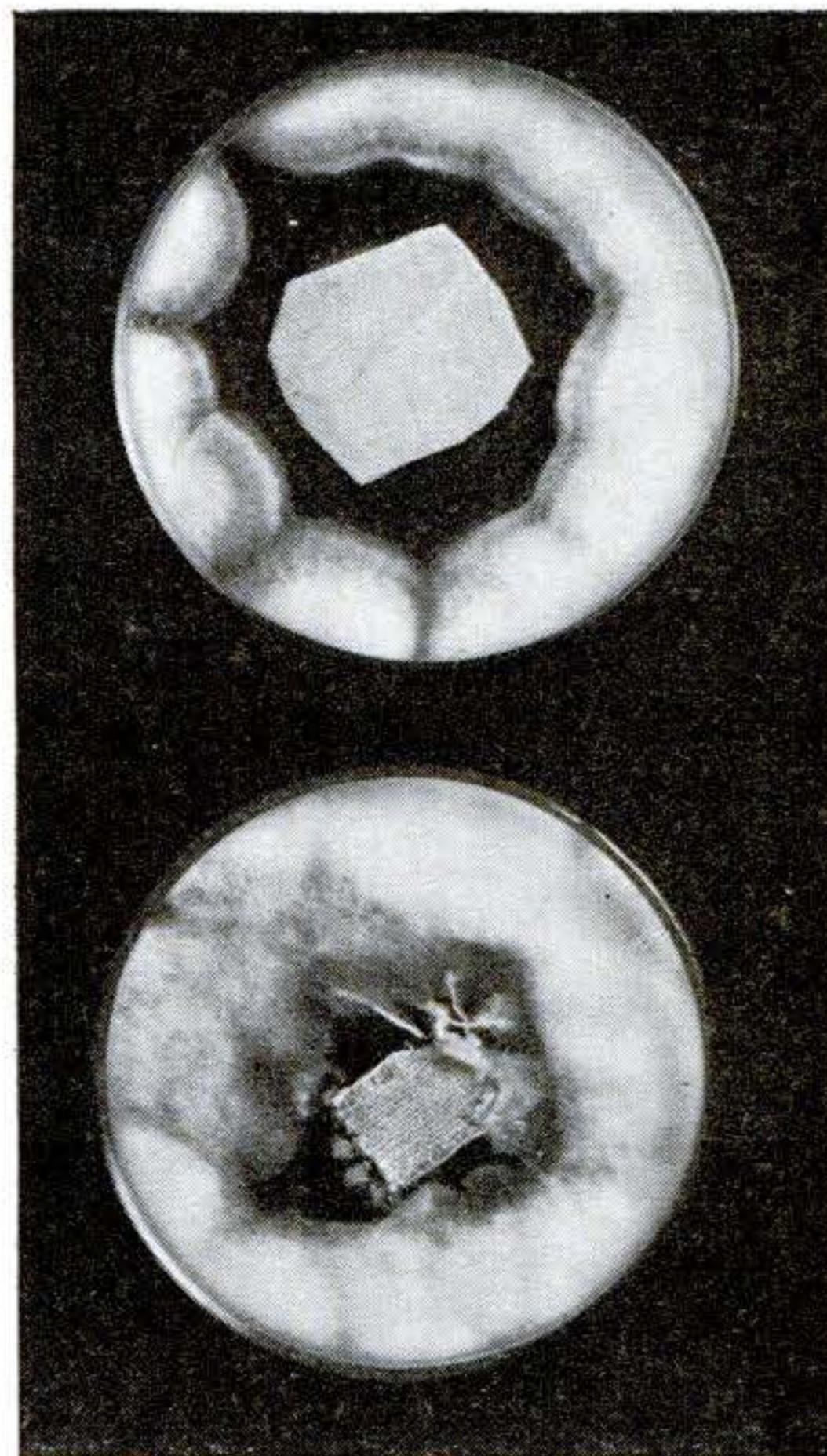


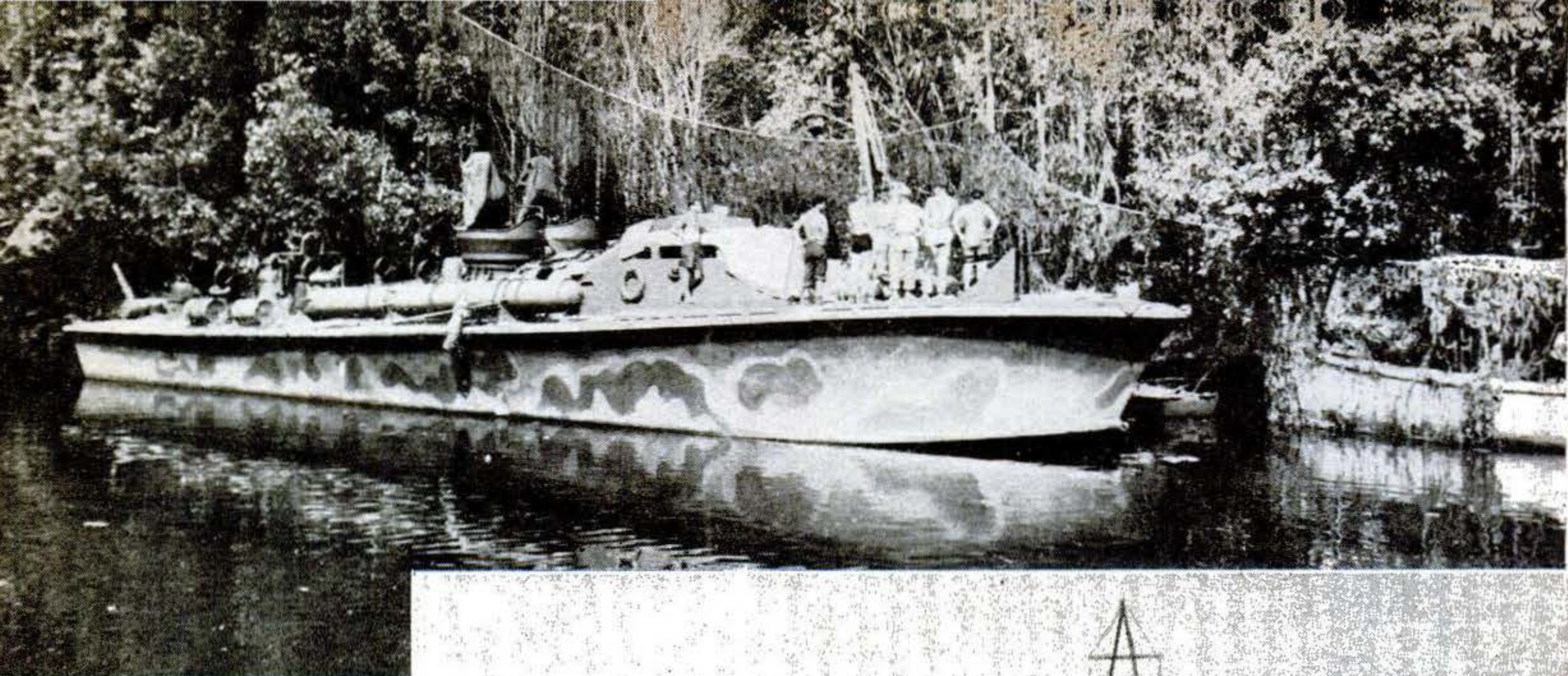
MOCK-UPS HELP TRAIN FLYERS. Time, gasoline, and plane wear are saved by the U.S.A.A.F. Training Command through the use of mock-ups to familiarize future air fighters with the conditions under which they will work. Above is a full-scale reproduction of the bombardier's compartment of a B-24 Consolidated Liberator bomber. Built at the Central Bombardier Instructors' School at the Carlsbad, N. M., Army Air Field, it helps returned combat veterans pass on their trade secrets to the men who will train future "egg-layers." Lieut. John Esh, student officer bombardier, is learning the layout of the instruments from Capt. Willard Von Jones, 26-year-old veteran bombardier from the Aleutian combat theater.

FUSES for hand grenades are X-rayed for safety by a machine developed by General Electric. Riding a movable belt, the fuses cross the beam from a 100,000-volt X-ray tube, which is focused on a fluorescent screen. Any change in the intensity of the glow of the screen, indicating an improper charge in the fuse, is detected by a photoelectric tube. A bell rings, a red light flashes, the offending fuse is marked with a dab of red paint, and a telltale recording is made on a chart. Four thousand fuses can be checked in an hour.

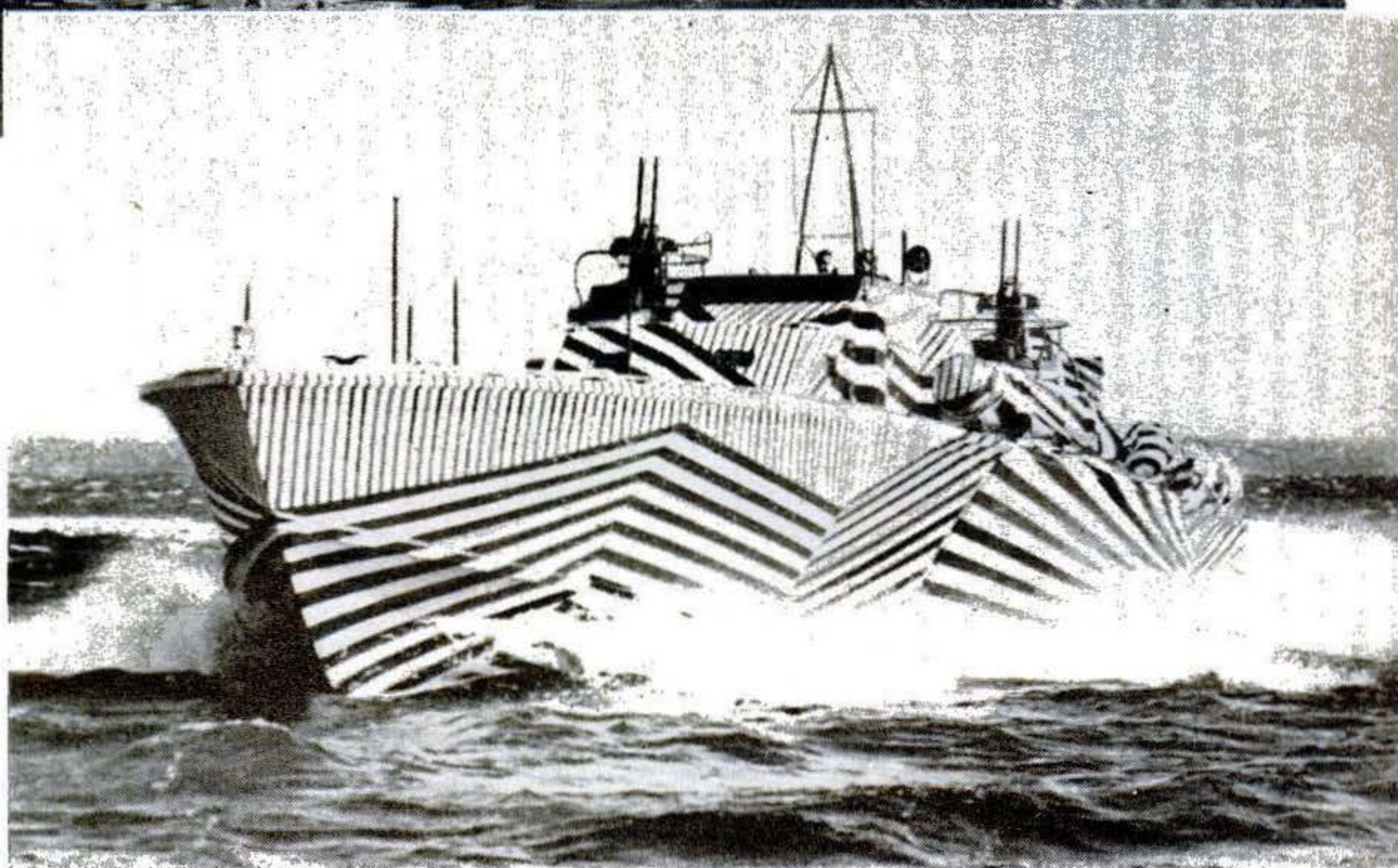


LASTING PROTECTION against bacteria and fungi is given fabrics and other materials by the "Puratized process" developed by Dr. Frank J. Sowa, of Gallowhur & Co., New York, N. Y. In the photo below, a treated sample of shoe lining (top) immersed in a culture of athlete's-foot fungus has a large "halo of inhibition," while an untreated piece is covered with fungi.





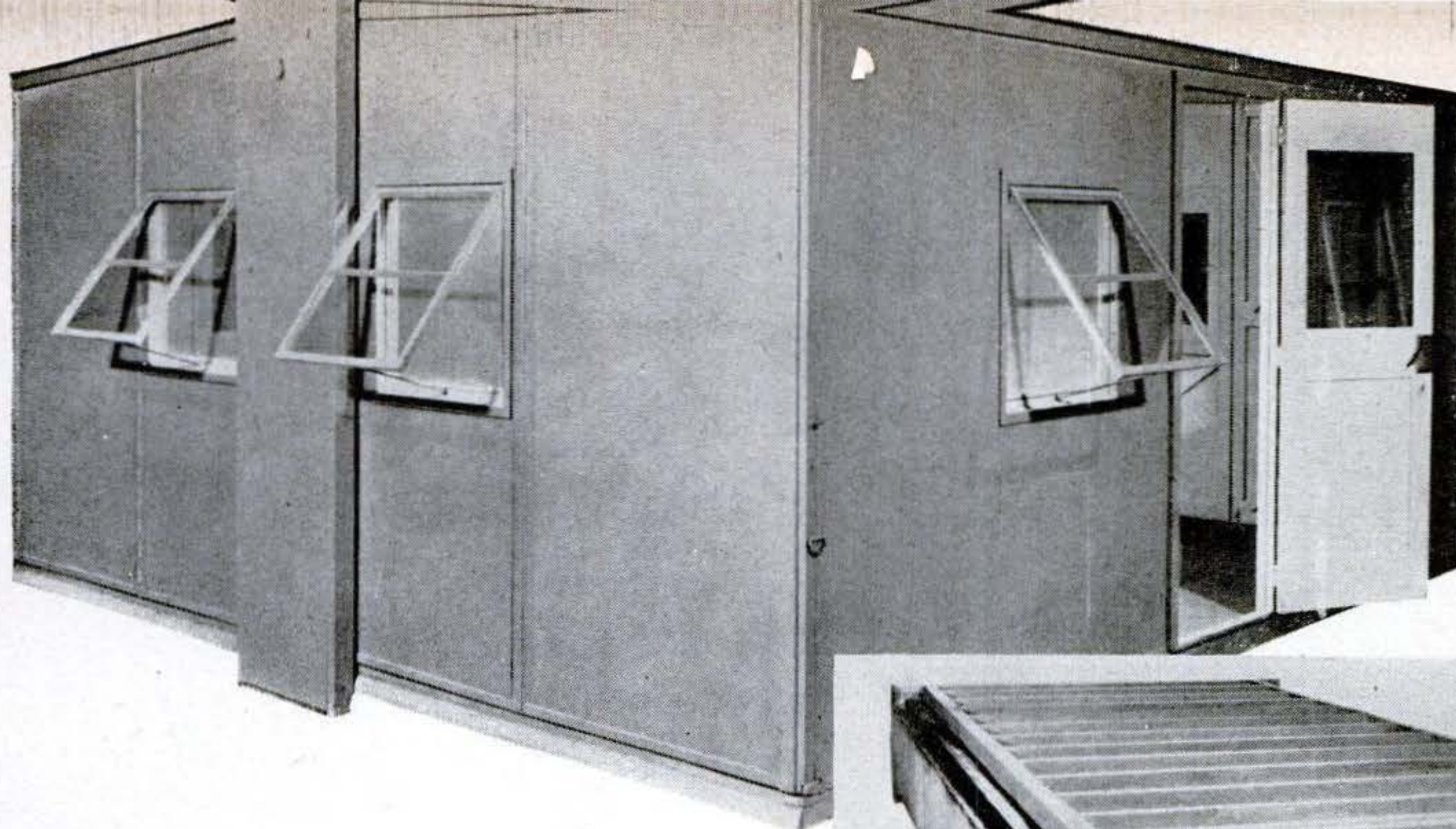
BATTLE DRESS of the Navy's PT boats has several styles, depending on where these hit-and-run craft are active. At the inlet and river-mouth bases of the South Pacific, skillful camouflage blends them with the jungle background, as above. Japanese call these PT boats "Green Dragons." At right, a camouflage of stripes is used to break up the outlines of a boat serving far from shore.



A WITCH'S BROOM is tied to the mast of a modern warship on its trial run, just as on early sailing ships. A successful trip, and the broom remains, signifying acceptance and a "clean sweep." Broom-keeper at the Tacoma-Seattle Shipyards, Tacoma, Wash., is Tom Gladding, right.

CASTAWAYS using the mirror below signal ships or planes within 10 miles. Sighting through the cross, they tilt the mirror to throw flashes of reflected light. The emergency device is made by General Electric.



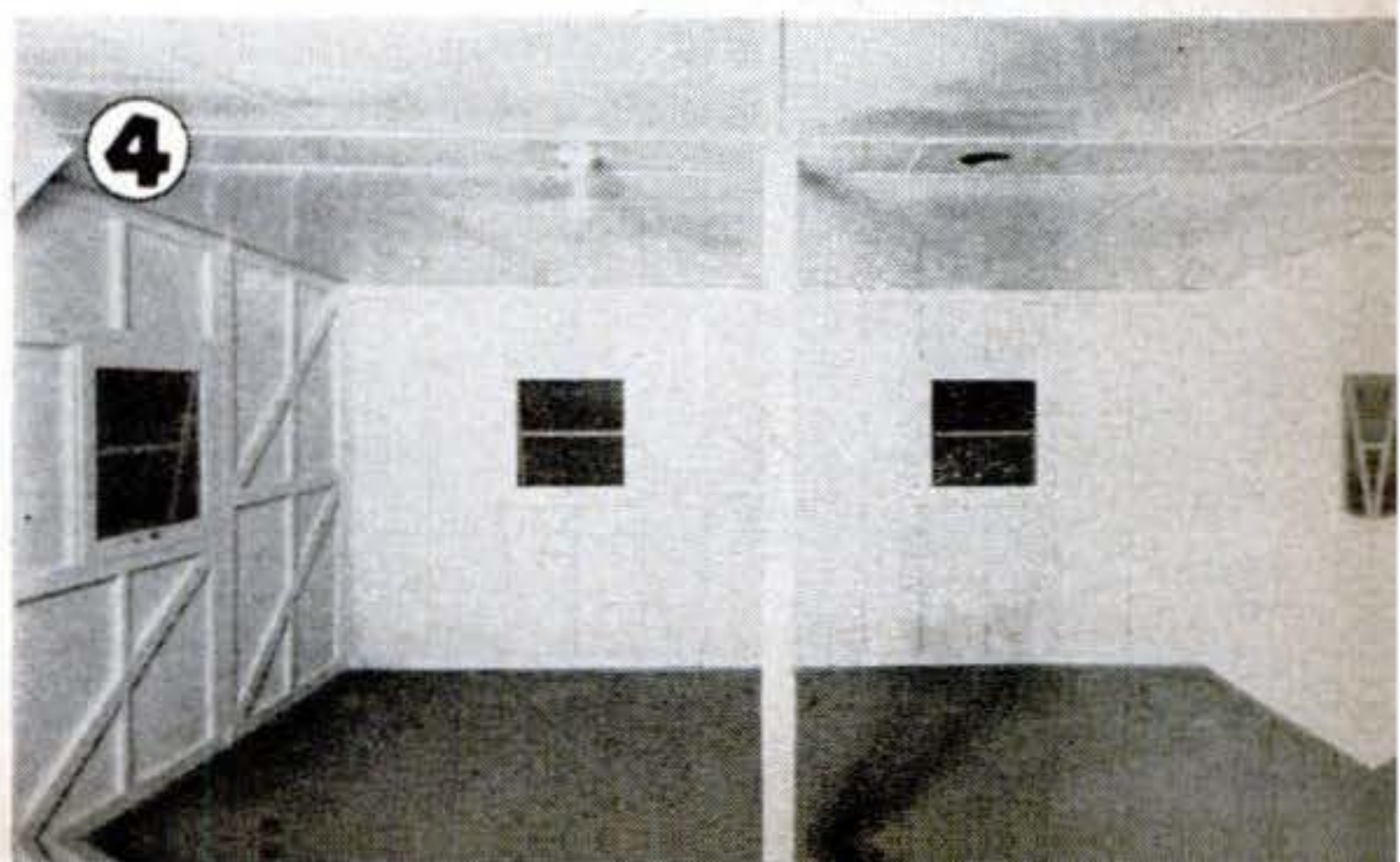
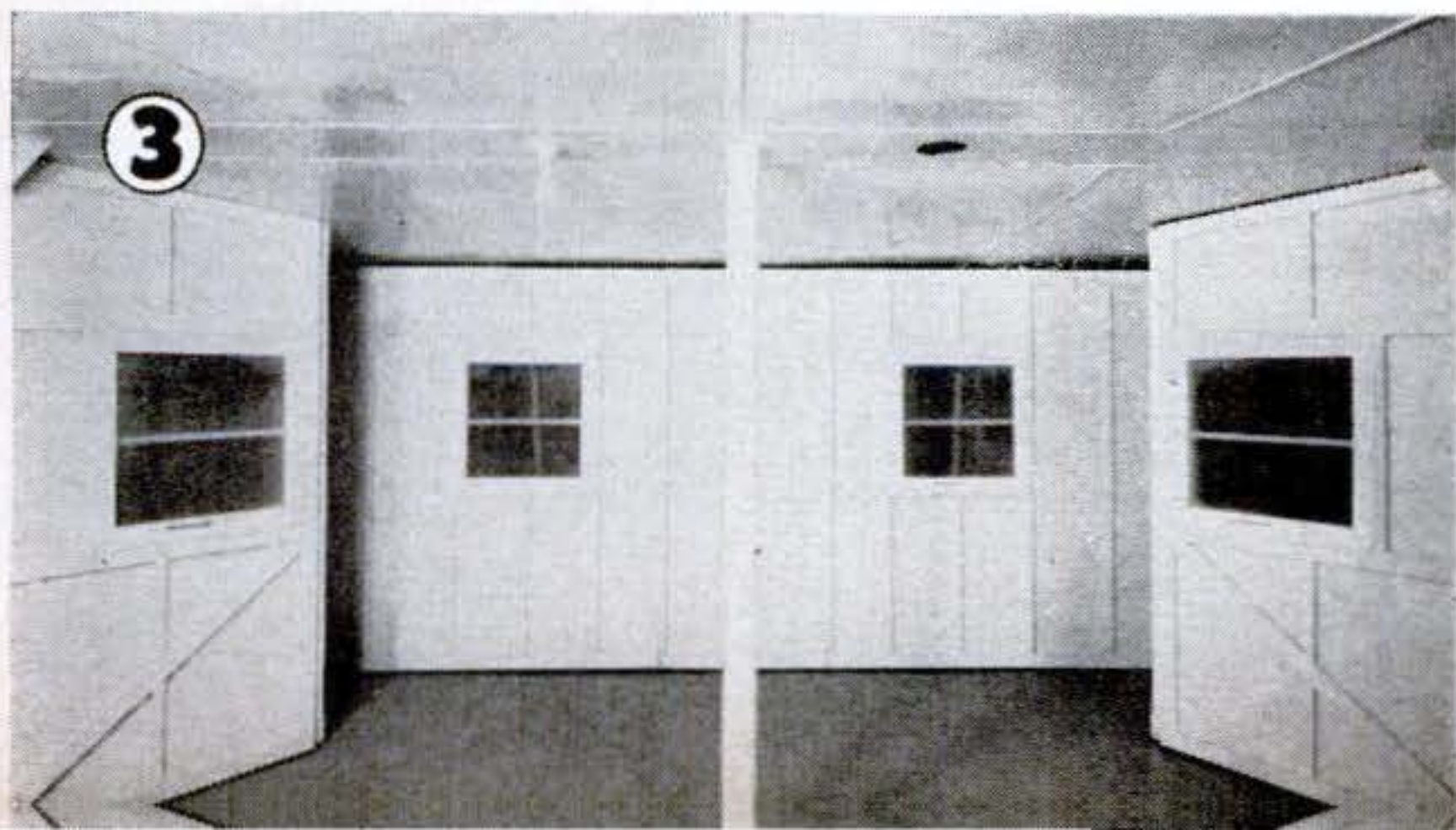
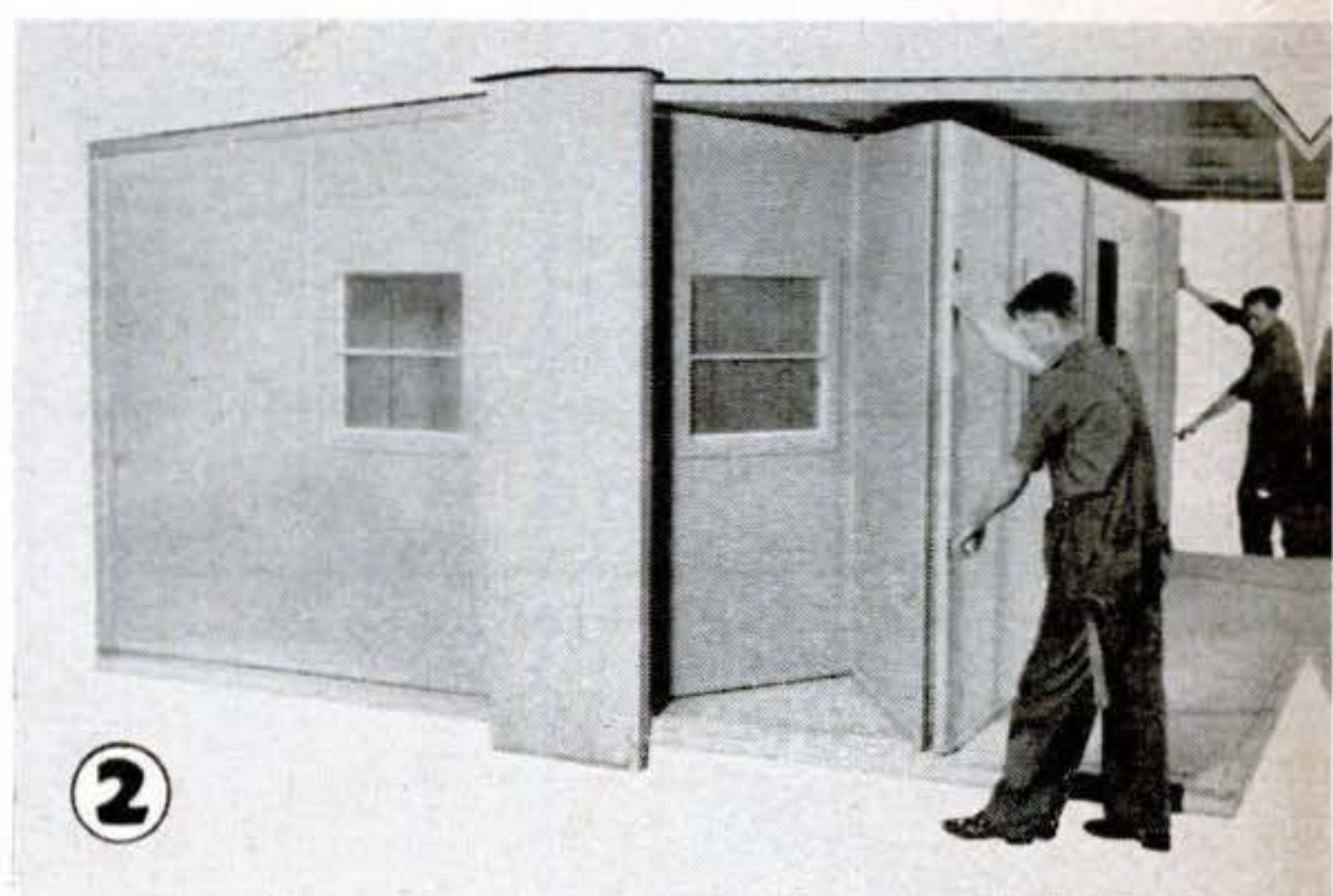


"SUITCASE HOUSES" FOR THE ARMY

A COLLAPSIBLE one-room house that can be taken out of a "suitcase" and set up in three minutes has been developed as a portable unit for use by our armed forces. Erected, the 16 by 15½-foot house provides floor space of 250 square feet. Folded (see inset), it fits in a case eight feet wide, 16½ feet long, and less than 26 inches thick.

William B. Stout, noted designer, has provided walls that fold open and shut like an accordion. The exterior of the 2,500-pound house, made by the Palace Corp., of Flint, Mich., is Homasote and noncritical lumber. Below, four stages in the erecting of one of these units, which the Army uses as kitchens, shops, offices, and first-aid stations.

"ACCORDION" WALLS SPEED THE ERECTION PROCESS





I Flew "Mitchells"

By **ROBERT L. CUNNINGHAM**

First Lieutenant, U.S.A.A.F.

IN 52 blistering raids across North Africa, the Mediterranean, and Rome itself, I helped blast an invasion path that eventually will lead our victorious troops into the heart of Berlin.

We precision-bombed, pattern-bombed, and skip-bombed the Axis troops until their commanders retreated toward fortified Middle Europe.

At first both the Germans and Italians poured flak into our wings like rain on a roof, but we learned to evade this cruel punishment so well that, of seven second lieutenants representing the entire pilot staff of the advance echelon for our bombardment group in Africa, six came through alive.

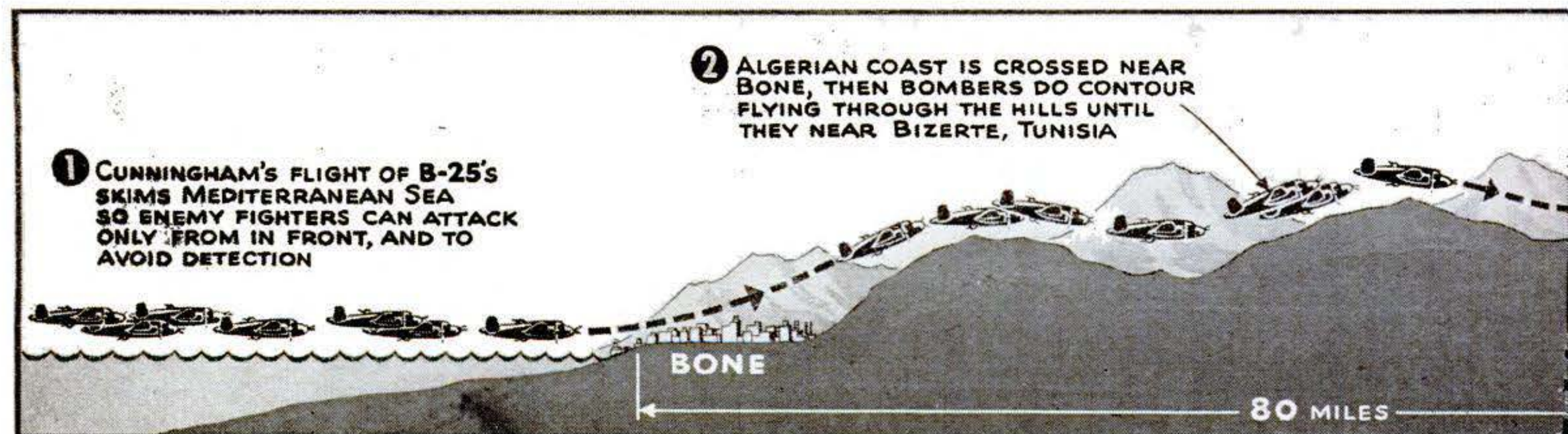
Only two years ago, I was a senior in liberal arts at the University of Southern California. Nineteen days after Pearl Harbor, I enlisted as an air cadet. Eleven months later, I was

Drawings by
STEWART ROUSE

in England, and on November 11, 1942, I landed at Casablanca, after guiding a flight of P-38 Lightnings from Britain. Except for a single sneak flight over the Ruhr in a Flying Fortress, intended to check on my nerve for combat, I had had no taste of war. Now I was due to lash out at Rommel in the desperate drive that pushed him into the sea.

General "Billy" Mitchell would be proud of us were he alive today. Yes, I am a "Mitchell" pilot, and proud of the great plane. Since General Doolittle's Tokyo raid, you may know this medium bomber better as the B-25. These planes are the fastest and most maneuverable mediums ever to take wing. In a heavy bomber, you fly far above the noise of battle, paste your target, and fight your way home. In the mediums, you are part of the battle itself, often roaring in "on the deck," pulling up sharply, and letting go

SIDI AHMED MISSION. An assignment to catch 50 JU-52 transports on a Nazi airfield outside Bizerte was the first big test of the air strategy of the "Gold-Barred Guerrillas." Here is the plan





GABES MISSION. Enemy troops concentrated in an orange grove were the target. Fifty Nazi fighters jumped the B-25's. With his top-turret gunner killed and his port engine out, Cunningham crash-landed

with everything you have, within direct range of all anti-aircraft weapons on the ground.

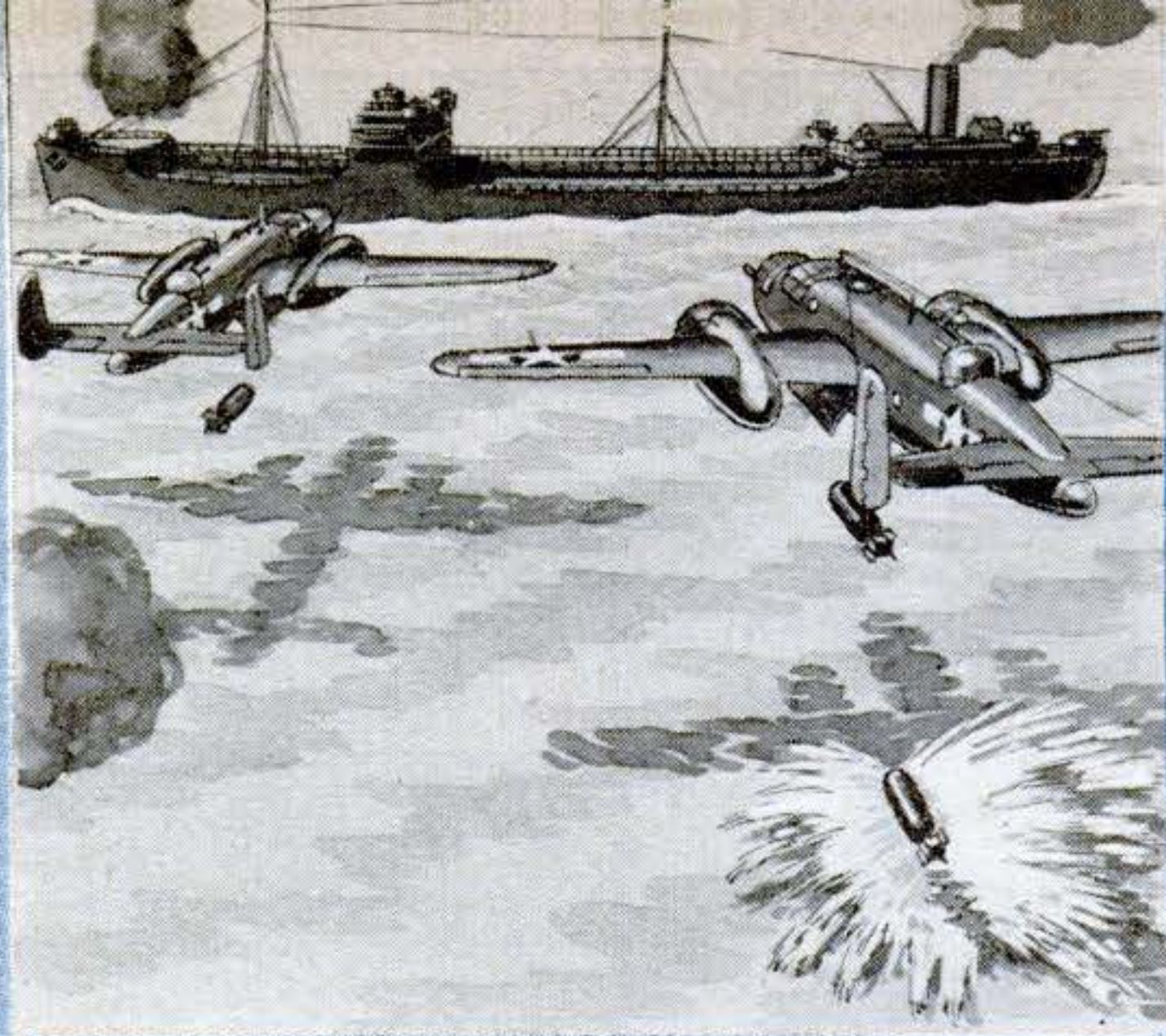
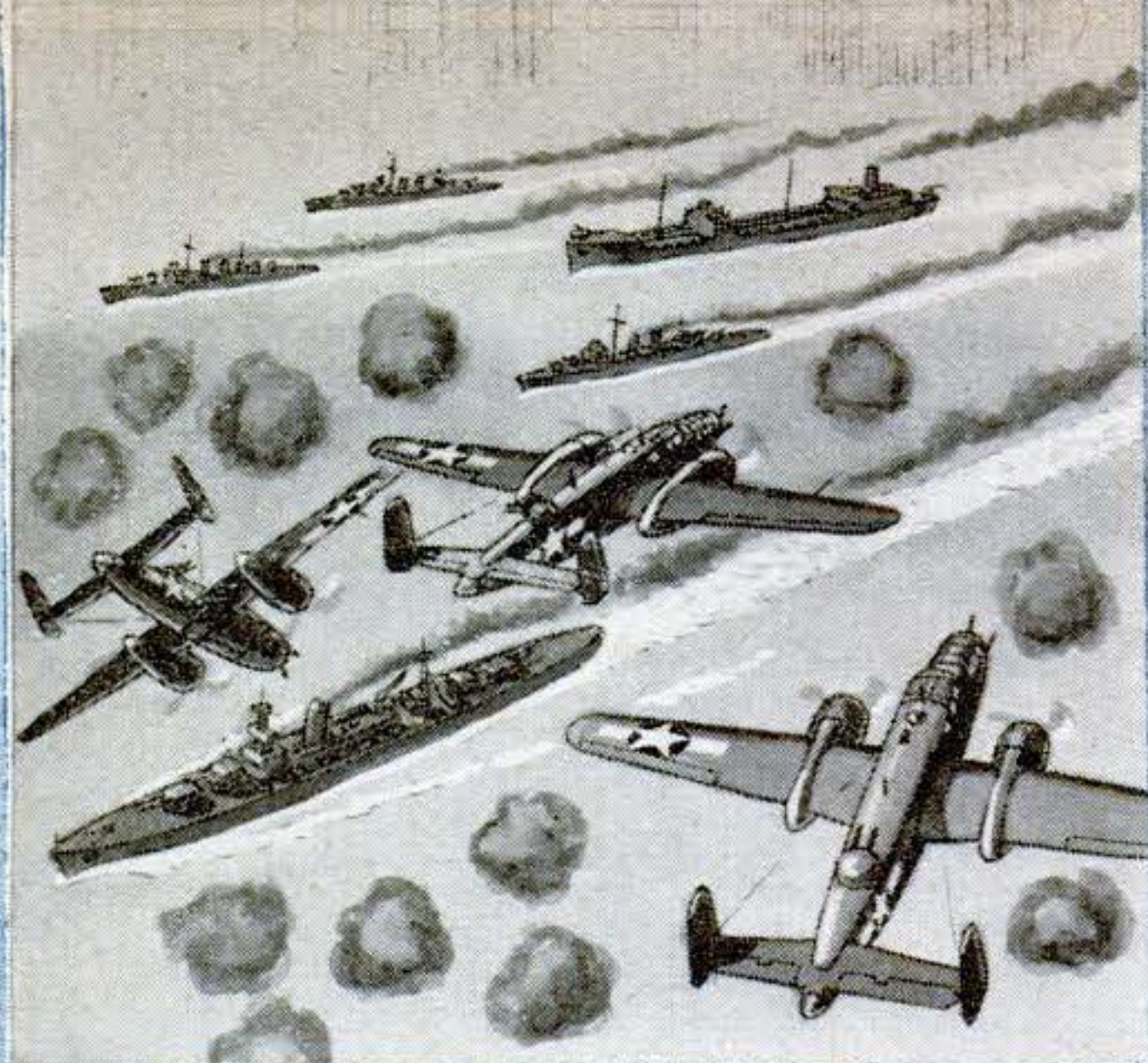
The Mitchells haven't missed a show in this war. Designed for pulverizing targets by level bombing, they are standard equipment today in five air forces, including the British, Russian, Dutch East Indies, and Chinese. Built at North American's Cali-

fornia and Kansas plants, these twin-tail, midwing machines carry a crew of five, several .50 caliber machine guns, protective armor, and more than 2,000 pounds of explosives. Their supercharged Wright engines drive full-feathering three-blade props.

Had the Axis threat not been so serious, I would have chuckled over our early tacti-

The problem was to approach the target low enough to escape discovery by ground detection equipment, then bomb from sufficient height to avoid most of the flak and keep clear of the concussion of their own bombs





A "MUST GET": 1,000,000 GALLONS OF GAS FOR ROMMEL

1 Searching the strait at 500 feet, the three-plane element spotted the convoy. While Miljius tackled the escorting cruiser, Canham and Cunningham braved the flak to take the tanker

2 Diving to only 10 feet above the water, the two B-25's streaked for the ship, dodging and twisting. Close in, they straightened out and at 500 feet turned loose with three 500-pound bombs each

cal plans. We had learned low-bombing tactics at home, sweeping in at roof-top level, dropping delayed-action bombs, and zooming 1,000 feet to escape their searing blasts. I was soon to learn that there's no tougher assignment than low bombing. The enemy gets set in foxholes and pumps a solid curtain of fire straight up as you approach. You must fly through streaming .30 and .50 caliber bullets, explosive 20-mm. and 40-mm. projectiles.

Our first mission carried us over Gabes. We were told that troops had concentrated in an orange grove, so we plastered the area and streaked for Casablanca. My flight over the Ruhr had not prepared me for this one. We saw no enemy on the ground, but out of nowhere 50 Nazi fighters jumped us. On their first pass, they killed my relief top-turret gunner and shot up the left engine. Three ME-109's circled like vultures until our stricken ship crashed, in enemy territory. As we tumbled out and ran for the bush, the Heinies strafed *Miss Mary Jane*—named for my best girl, back in California—until she exploded.

"Friendly" Arabs rescued us. After two of the boys had given them the shirts off their backs for the favor, they turned us over to an Italian patrol. Luckily, the Italian officer missed the .45 I carried in a shoulder holster under my leather jacket. When we were being driven away, I stuck the gun in that officer's face and demanded our side arms. We not only got the guns; the Eyties started walking. We hid in the hills until one of our patrols came by.

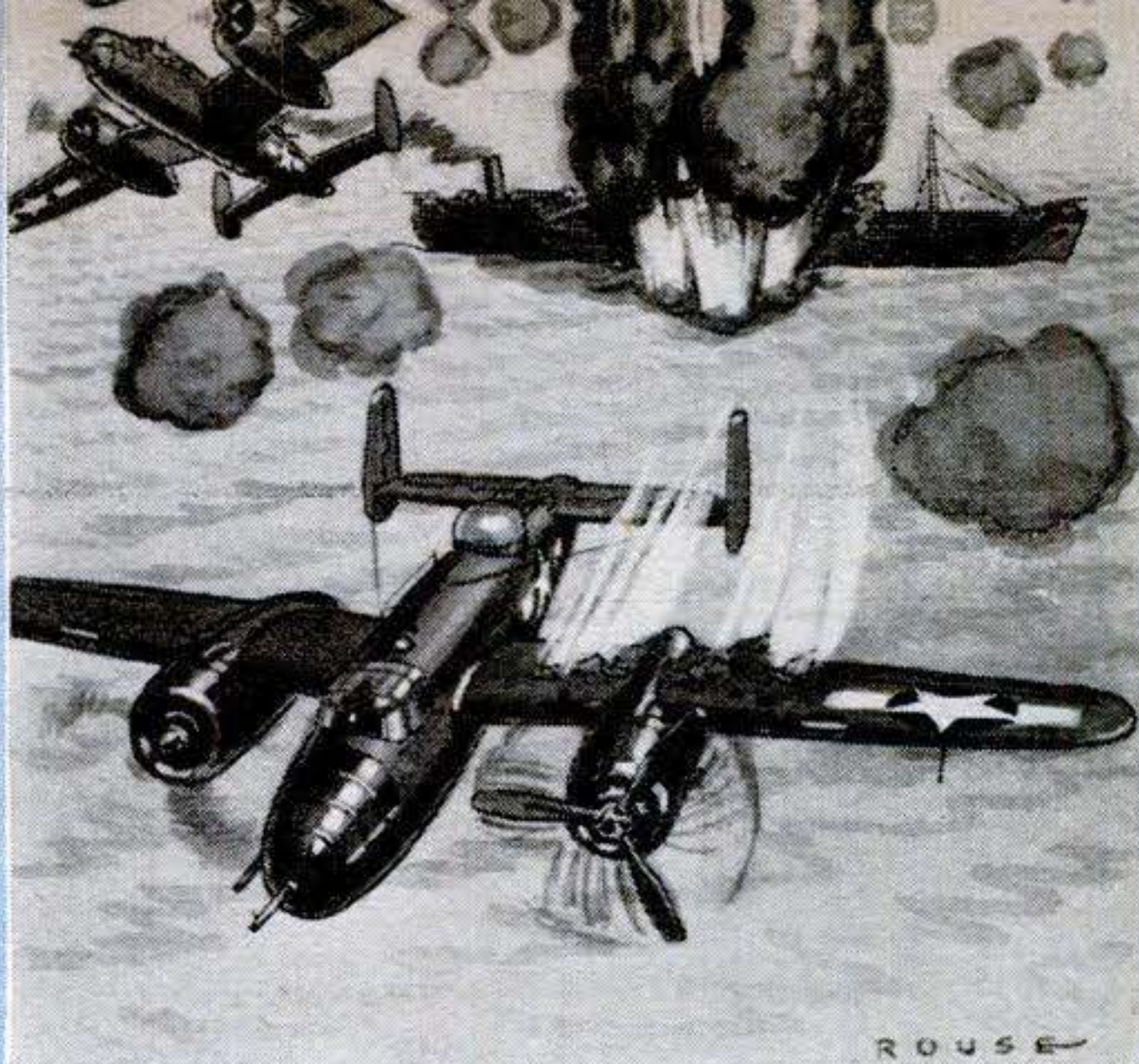
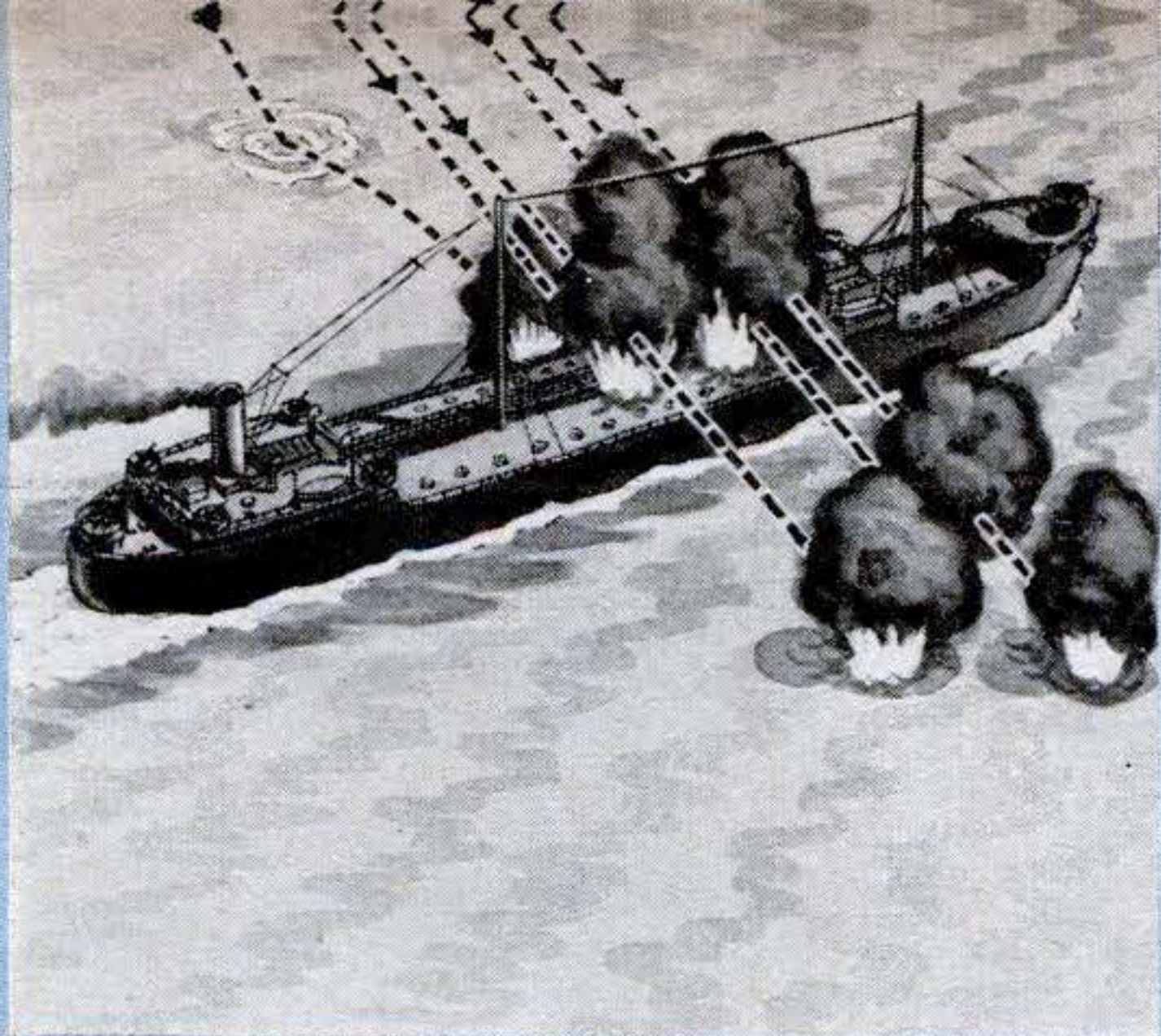
A few days later, we drew our second mission, the airdrome at Sidi Ahmed, in

Bizerte. "Fifty JU-52 transports on the field," Intelligence reported. How should we go in to surprise them before any could be flown away?

We huddled on that one. Joe Helsaback, from Walnut Cove, N. C., had one idea, Frank Gschwandtner, from Fort Atkinson, Wis., another. "It's a cinch," said John Beatty, Kittanning, Pa., "we gotta keep their air power on the ground." Arthur Canham, a San Francisco boy, declared we must hit the deck (contour fly) until the target was approached. I suggested we sweep in from the sea, skimming the waves to protect our top, rear, and bottom. Bill Bishop, New York, agreed with my idea, and Dick Marsh, Philadelphia, sighed for some delayed-action stuff to replace the bombs we were carrying.

Our tactics began to develop on the Sidi Ahmed raid. We dared not go in at 50 feet, for the bombs would explode in our faces. We couldn't sweep in at 8,000, for the Germans would pick us up with detection equipment and bracket us before we hit the target. So we struck out over the Mediterranean, skimming the deck until we were off Bone, where we turned inland, contour-flying over the hills until 10 miles out of Bizerte. Then we started climbing 1,500 feet a minute, holding the air speed at 160. (Ground fire turned loose at Ferryville, 40 miles from the airport.) At 8,000 we leveled off, roaring on through the hell of steel. Poor Bill Bishop went down with a direct hit, the only one of our pilots not to come safely through the campaign.

As soon as flak began to bump us around the sky like kites, we threw the ships into



SKIP BOMBING KEPT THE AFRIKA KORPS TANKS THIRSTY

3 One of Cunningham's bombs skipped, striking the near side of the ship and exploding below the water line; another hit the deck, firing the cargo. Canham also scored with a hit on the deck

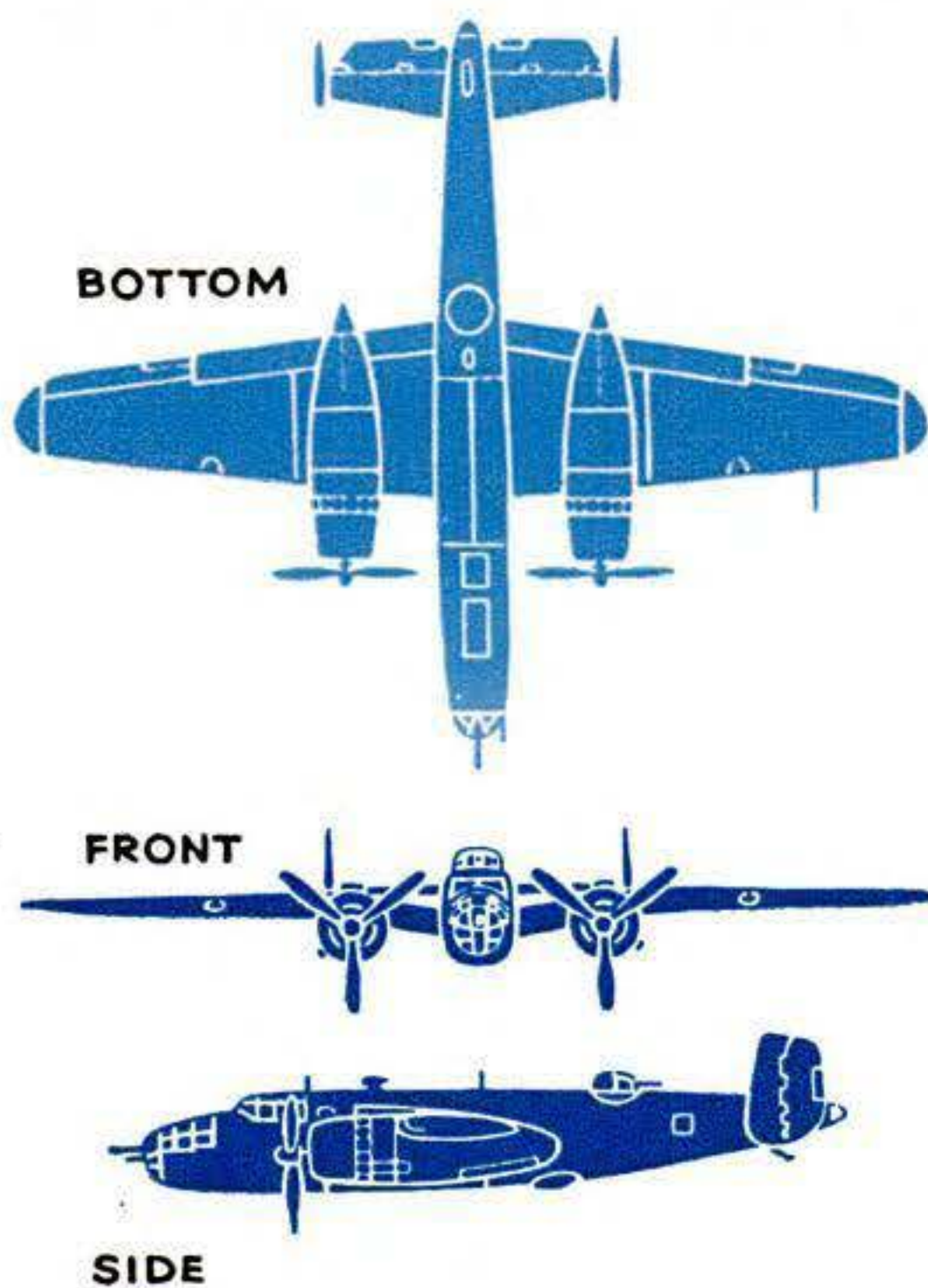
4 Four seconds later, when the delayed-action bombs went off, the Mitchells were a quarter of a mile away. Cunningham was in trouble, with his port engine shot out and its prop windmilling

an undulating skidding motion. A little right rudder, slight left rudder, dive slightly, climb a bit. I looked down, saw four lights blink. Seconds later, pebbles cracked against the bottom of the wings. How those missiles were punishing the planes, I learned when we landed. It was a horrible mission tactically, though we plastered the target. For five days we worked on those ships in the blistering desert heat before they were ready for combat once more.

Tough fighter opposition met us every time we went up, for the Germans usually outnumbered us five to one. Though the B-25 can turn inside some fighters, as I have proved many times, there's no point in tempting their guns needlessly. We pilots chinned about tactics every time two or more got together. "Speed of a bomber in combat," we agreed, "is O.K.—but it's maneuverability that will bring us home." A bomber can't run away from a fighter pilot. He can make four passes at you, spitting machine-gun bullets and cannon projectiles, as easily when you're doing 280 miles an hour as when you're crawling at 180. I went up in a Spitfire one day, placing myself in the position of an enemy pilot

to check his reactions to a B-25 squadron. As I noted the turrets swinging rapidly in my direction, keeping me dead in their sights no matter how I rolled and dived, I understood why so many enemy flyers think twice before moving in to attack. I have often seen Nazi fighter pilots dip a wing in our direction two and three times before plunging in toward our formation. They're no fools, those Germans—and certainly they're no supermen, either.

Quickly our board of strategy (we called ourselves the "Gold-Barred Guerrillas") evolved other tactics. We continued going in on the deck. German fighters soon learned not to sneak up from the rear, for the terrific prop wash of the B-25 will dash a small plane into the ground or sea quicker than its pilot can say *über alles*. Nearing the target, we'd stick our noses into a climb, level off at 8,000, climb on to 9,000, dive to 8,000, level off, dump our loads. While approaching the target and fleeing for home, we threw the ships into a sickening combination of skidding and roller-coaster plunges and zooms, varying altitude 1,000 feet at a clip. Again, we would



FACTS ABOUT THE B-25

Wing Span	67 feet 6 inches
Length	54 feet 1 inch
Height	16 feet
Wing Group Area	610 square feet
Weight (approx.)	35,000 pounds

(Continued on page 208)

Shields for Sky Fighters

Layers of glass and plastic, like your car's safety windows, resist shattering by bullets.

Photographs by ROBERT F. SMITH

THINGS were getting hot for the rear gunner of an American medium bomber over Tunisia, one day a few months ago. A Messerschmitt was on his tail, and 20-mm. explosive shells whizzed closer and closer, until one of them smacked right against his window. By all the rules, that should have ended the gunner's career. The fact is that he wasn't even scratched.

Incredible as it seems, a piece of glass saved his life. The window was a typical installation of a modern aviation material for protecting combat flyers, which American factories are now turning out on a mass-production scale. Cautiously, its makers and the armed forces call it "bullet-resistant glass." They emphasize that it was never intended to stand up against explosive shells, though it has done so on occasion. What the manufacturers do say, and rigid Army and Navy specifications demand, is that a block of this glass 5½ inches thick will stop a .50

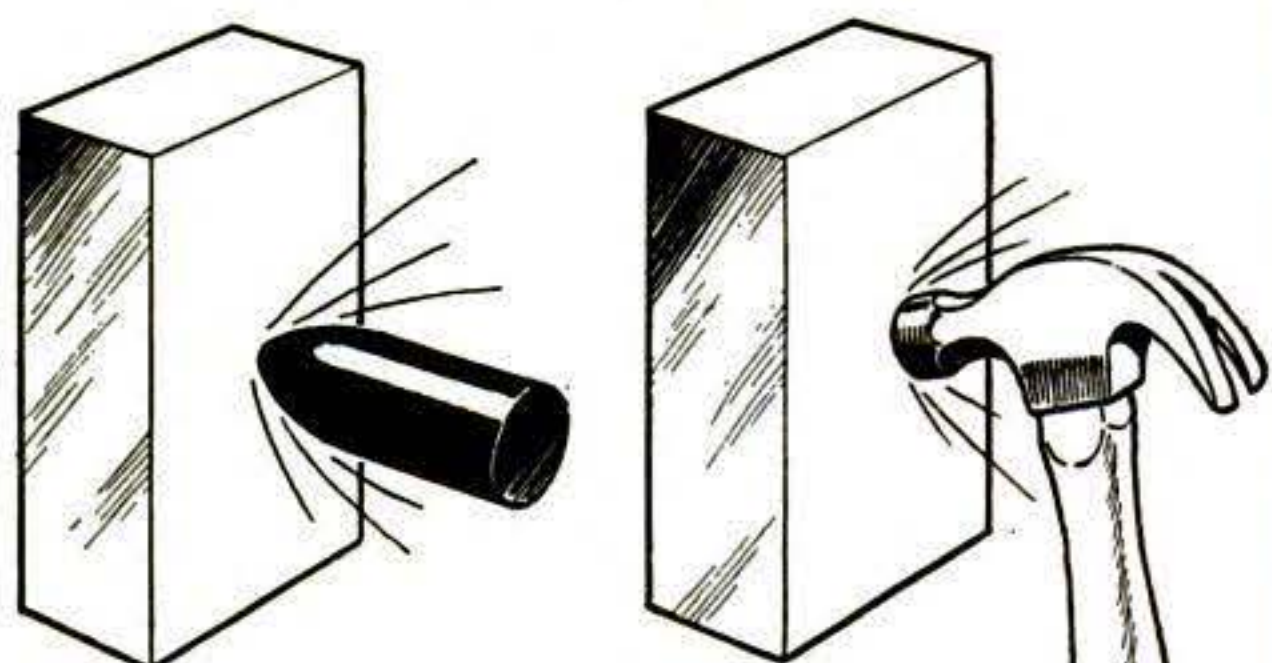
caliber armor-piercing bullet, striking head-on, at a range of only 50 yards. And that thickness may be considerably reduced if only oblique hits, by far the more frequent, are to be guarded against.

In principle, bullet-resistant glass takes after its ancestor, automobile safety glass. Both consist of multiple sheets of polished plate glass, separated by films of transparent plastic. These intervening layers of elastic material are bonded to the glass by heat and pressure. They serve to prevent a crack from spreading through the entire thickness, confining it to a part of the "sandwich." Also, they oppose radial cracking and shattering.

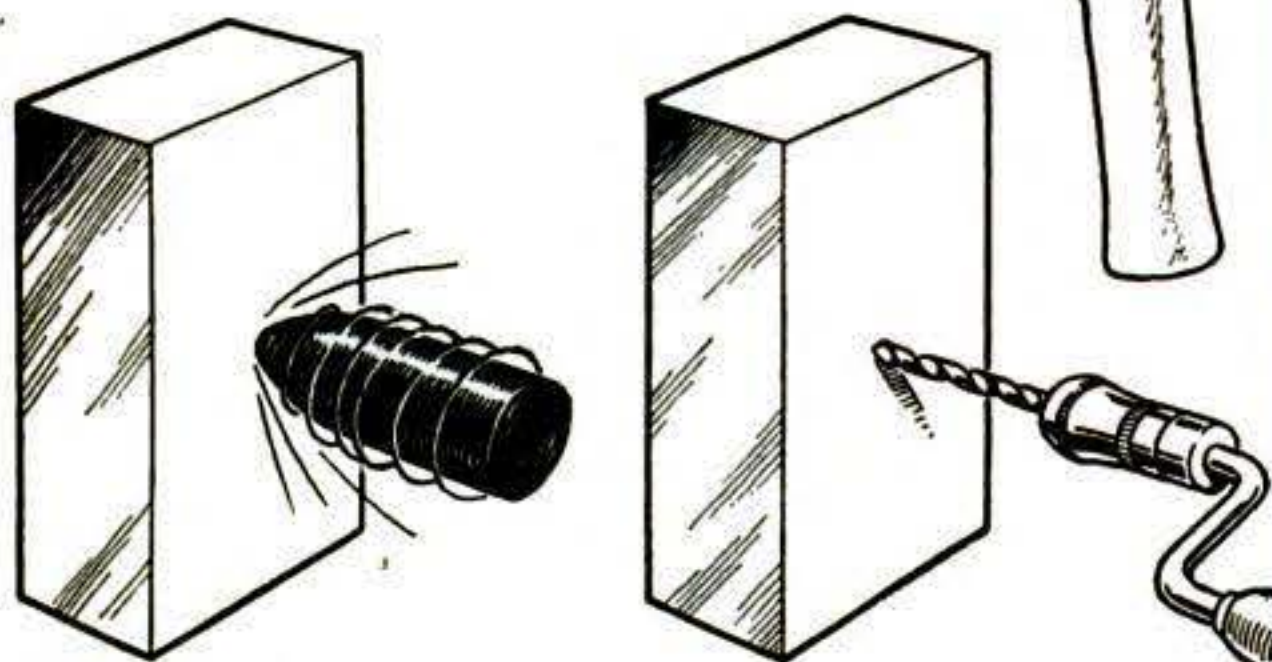
Much depends on the type of plastic used. The kinds first employed for auto safety glass had drawbacks, of minor importance to motorists but serious to airplane crews. For example, long exposure to sunlight tended to discolor the plastic—only slightly in a thin window, but considerably in one of enough layers to resist bullets. Another difficulty was that extreme cold made the plastic brittle, robbing it of resiliency and weakening the bond between layers of glass. Not long before the war, chemists perfected a synthetic plastic, known as plasticized vinyl butyral, which met all objections.

Successfully tried out in automobiles, and then in armored cars used for transporting valuables, bullet-resistant glass was fully developed just in time for war needs, which now consume the entire supply. After hos-

BULLET-RESISTANT GLASS MUST COMBAT TWO FORCES

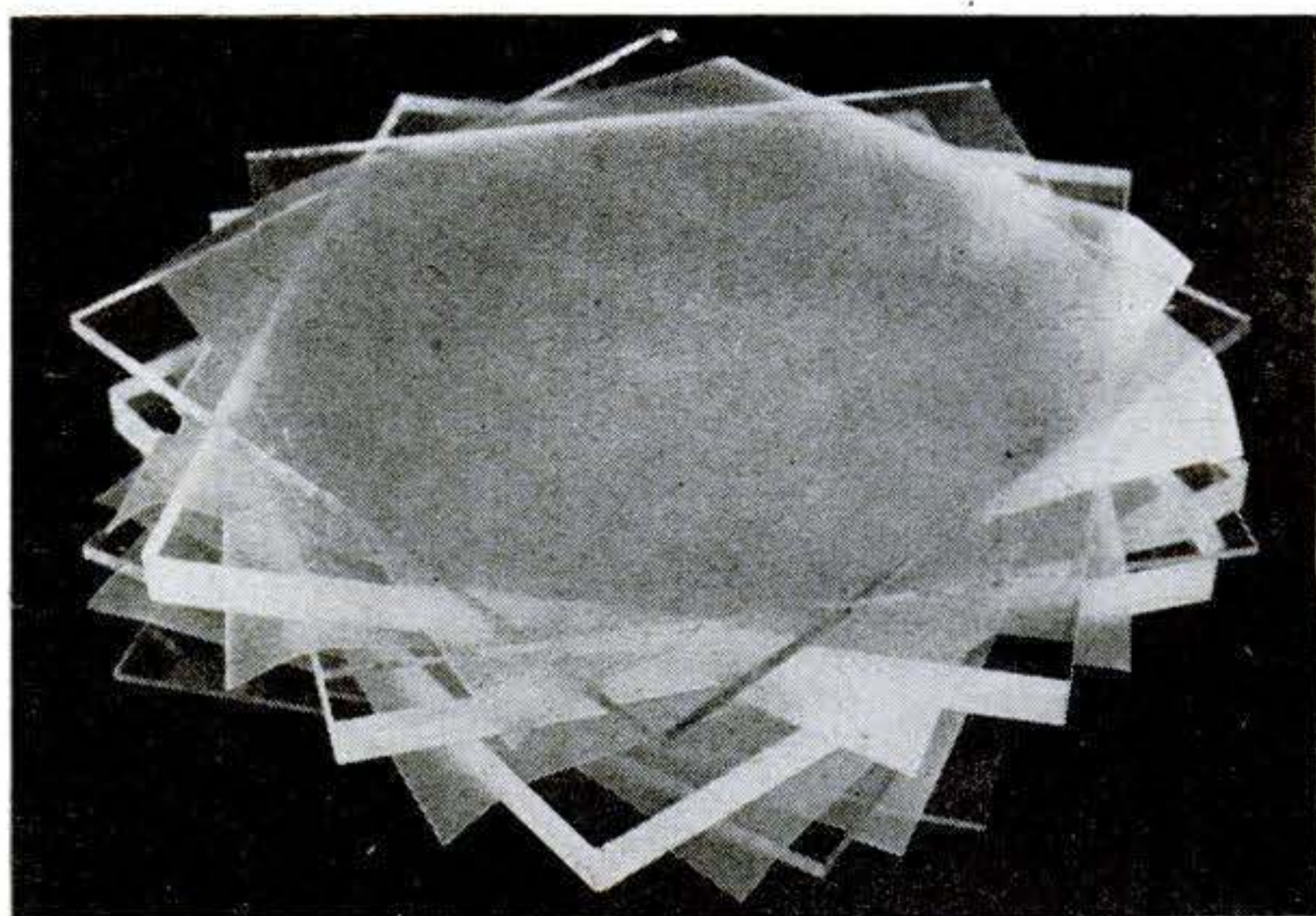


① IMPACT FROM BLOW



② BORING FROM ROTATION OF PROJECTILE

"DEFENSE IN DEPTH"



The glass is actually a "sandwich" composed of layers of polished plate glass and transparent plastic welded together by heat and pressure



A small panel of the new glass—an improvement over the prewar safety glass used in passenger cars and armored trucks—protects the head and shoulders of this P-38 pilot. Because it weighs 13 pounds for every square foot an inch thick, it is employed only in vital areas

ilities end, civilians will enjoy its benefits.

For airplane use, bullet-resistant glass of four or five layers replaces or supplements windows previously made of plastic alone, which had practically no resistance to bullets. Bullet-resistant glass has the added advantage of withstanding scratches, which in time impair visibility through windows of plastic. Like plastic, it can now be formed into many special shapes for airplanes. Cylindrical and conical shapes have been produced.

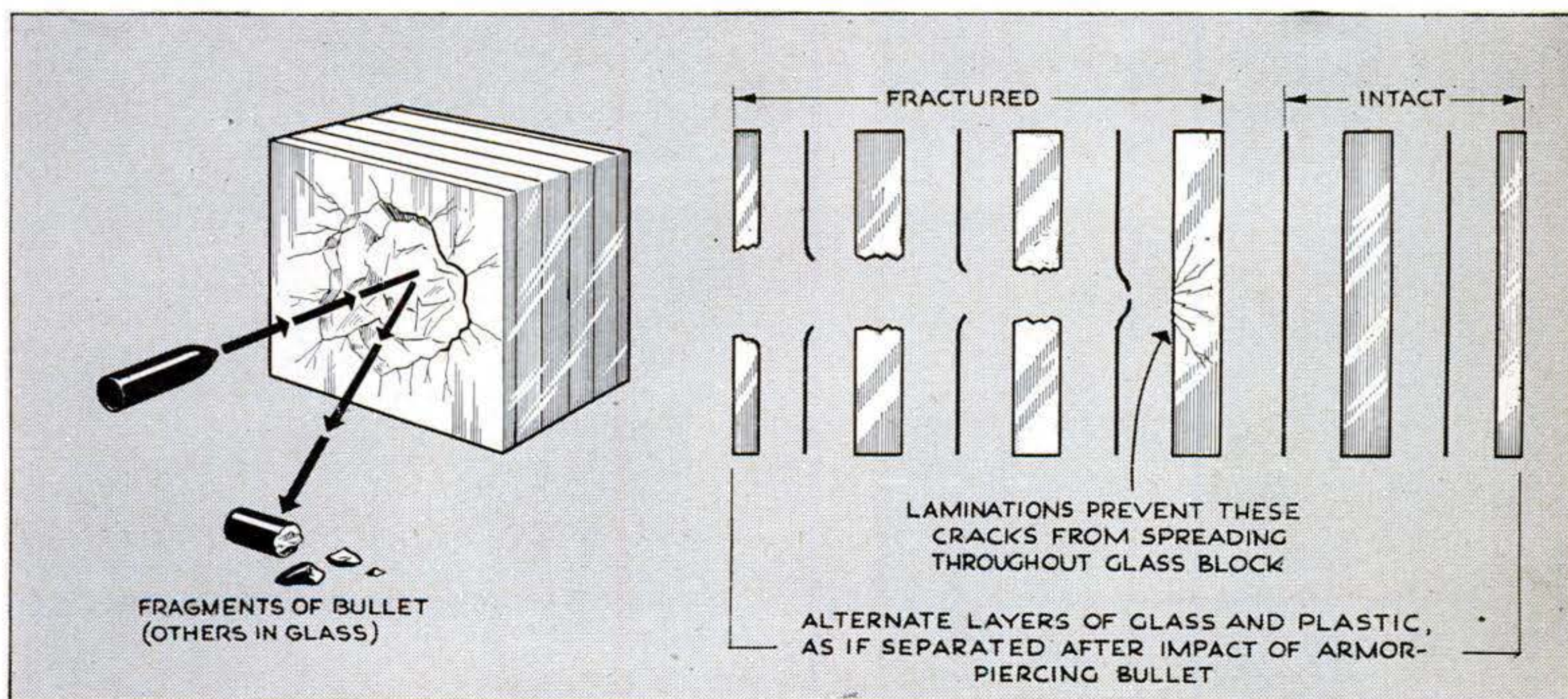
On the other hand, the considerable weight of the new glass has presented a

problem. One square foot of the material, one inch thick, tips the scale at 13 pounds.

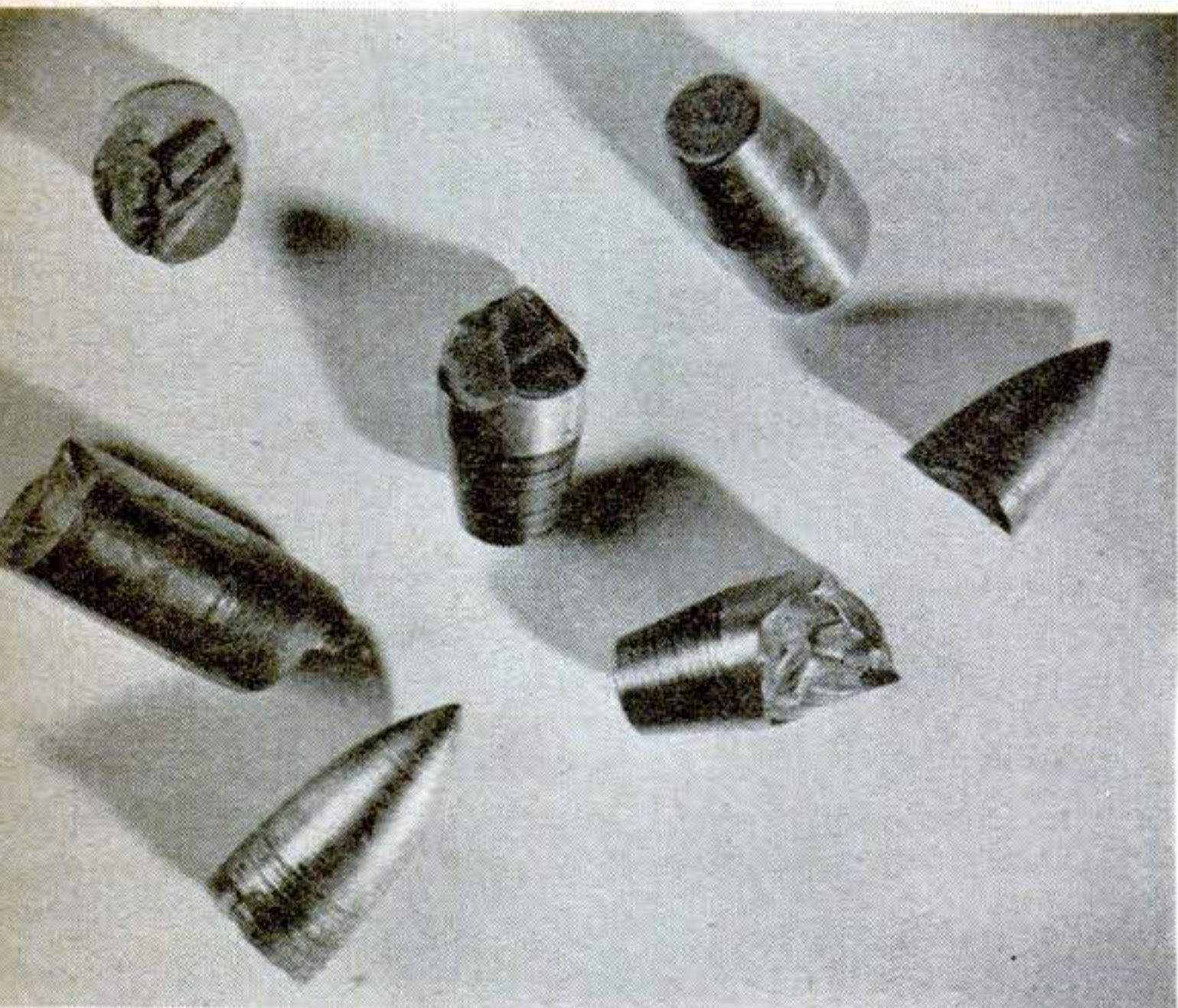
How to make windows as light in weight as possible, therefore, is a question that has preoccupied makers and users. One solution has been to keep down their dimensions and mount them close to the eyes of a flyer so as not to restrict his field of vision. A window as small as a foot square gives the tail gunner of a bomber plenty of view to sight his weapon. Likewise, a small block of the glass may be mounted within the cockpit of a fighter, just in front of the pilot's head.

Front-line observers, reporting on the pro-

IS THE SECRET OF BULLET-RESISTANT GLASS



portion of air casualties caused by bullets of various calibers, have helped to show the minimum of glass thickness consistent with safety. In the same way, the angle at which most bullets strike a craft of a given type has come in for study. According to report, the Army wanted to find out the chances of



GLASS VS. BULLETS. When a .30 or .50 caliber bullet rips through even a thin piece of the new glass, it is the bullet that shatters, as witnessed by these fragments of bullets fired in the testing range shown on opposite page. Below is an American bomber's "rear window" that did not come off second best. Shown being replaced at an American repair depot in Australia, it stopped a bullet from a Zero before it could bore halfway through



one fighter pilot shooting another while the two planes approached head-on. Two skilled pilots took up planes and tried it, just short of actually shooting. To make sure that their paths would coincide, they came at each other with a straight highway for a guide. With the terrific speed of such planes, both pilots concluded, the fleeting interval between coming into range and swerving to avert a midair collision would have been too short to get in a single machine-gun burst. The importance of this finding may be judged by the fact that if a piece of bullet-resistant glass $2\frac{1}{2}$ inches thick will stop a bullet heading straight for it, its thickness may be reduced to $1\frac{1}{2}$ inches to turn away a bullet at 45 degrees, and to $1\frac{1}{8}$ inches for a hit at an angle of 30 degrees with the glass.

Currently being investigated is the possibility of using two or more blocks of bullet-resistant glass, with the combined thickness of a single layer, but set some distance apart and at an angle to each other. One hoped-for effect would be to tumble the bullet in flight, so that it would tend to sideswipe the second block instead of striking nose first. Even a deviation as small as five degrees reduces the penetrating power of a bullet.

Ultrahigh-speed photographs made in the Creighton, Pa., research laboratories of the Pittsburgh Plate Glass Company—reveal what happens to a bullet after it penetrates relatively thin sheets of the material. Through a cleverly arranged set-up, a single picture tells the whole story.

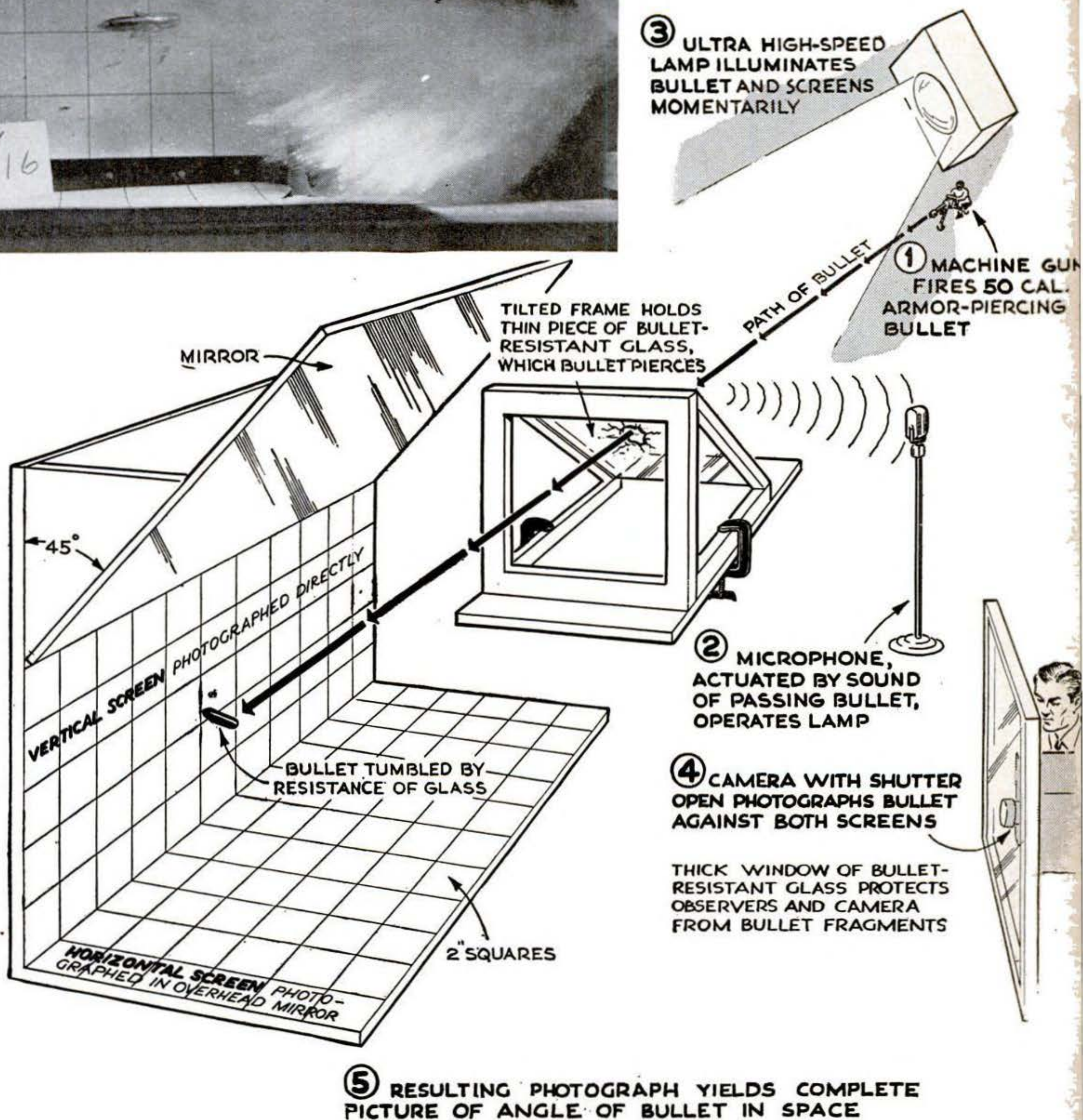
At one end of a basement test range, the experimenters fire a single round from a standard aircraft machine gun, whose mount is embedded in concrete. The bullet bores through the piece of glass, 50 yards away. An instant later, its picture is taken as it passes a pair of vertical and horizontal sheets of cardboard ruled with two-inch squares. To do this, the camera shutter is left open in the darkened range. A microphone, four feet nearer to the gun than the camera, picks up the sound of the passing bullet. This serves as the trigger to set off an Edgerton-type lamp, which stabs the bullet and marked screens with $2/1,000,000$ of a second of illumination.

Studies of the pictures show that an inclined plate tumbles a bullet effectively—and that even a thin vertical piece of bullet-resistant glass has some effect. The views also show that laminated sheets as thin as half an inch can rip the copper jacket from a bullet, and even smash the projectile into fragments. From such fundamental research, advanced arrangements of bullet-resistant glass are expected soon to emerge that will save the lives of still more airmen.

—ALDEN P. ARMAGNAC.

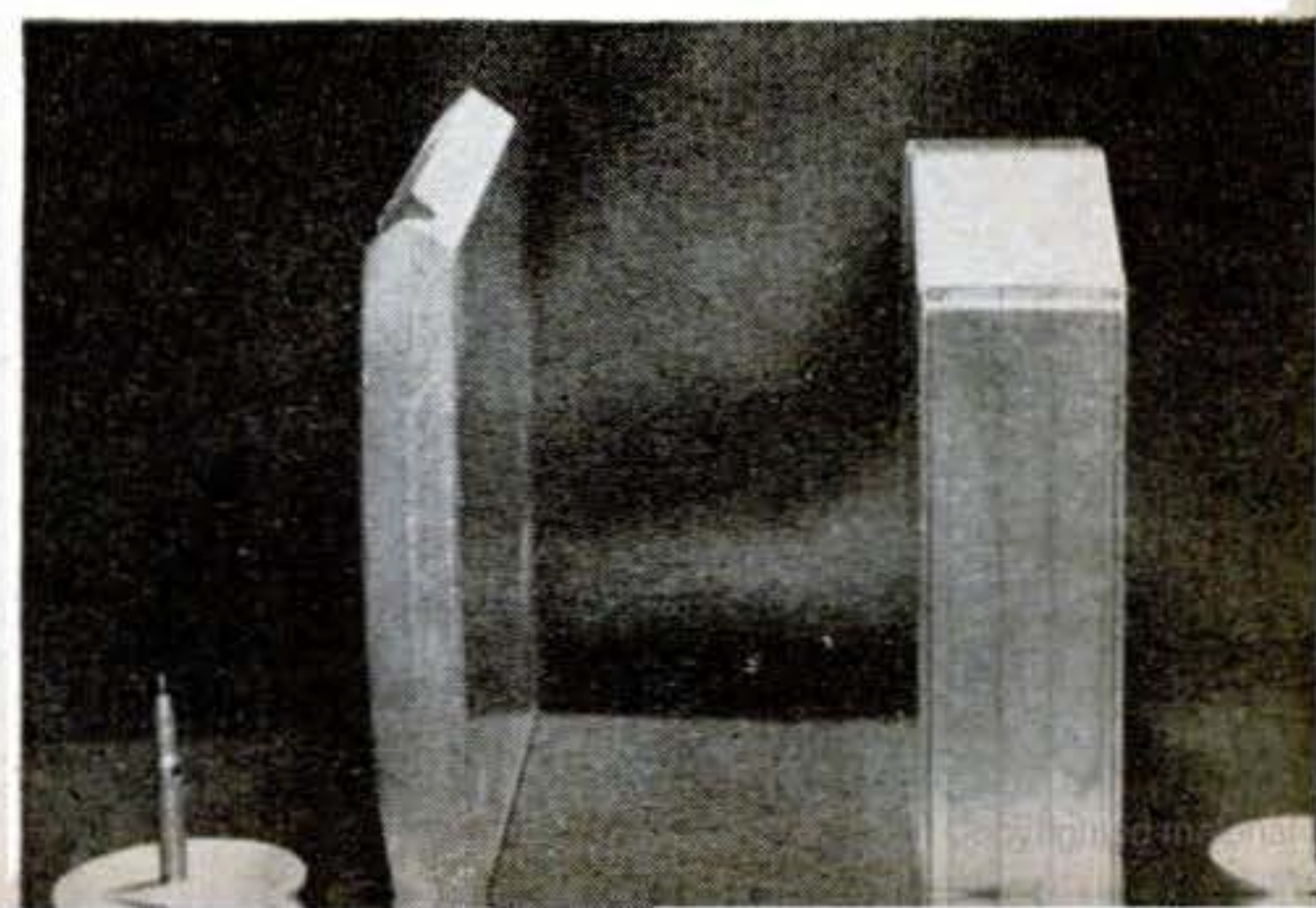
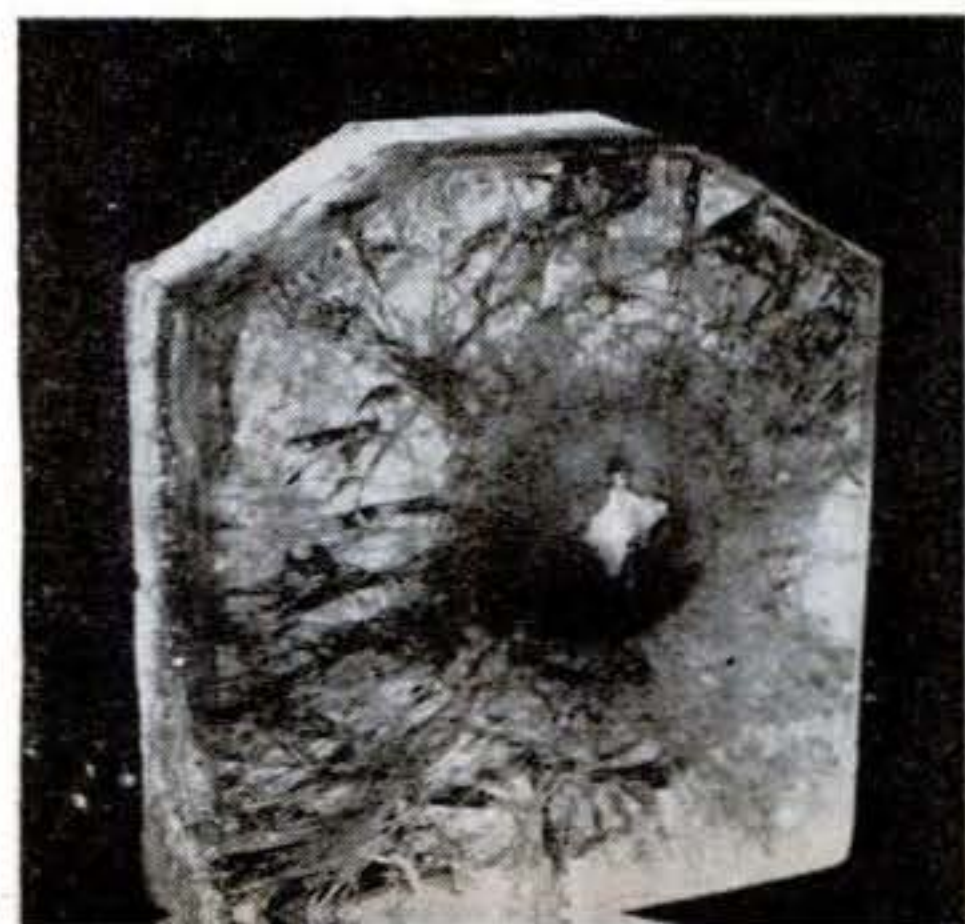
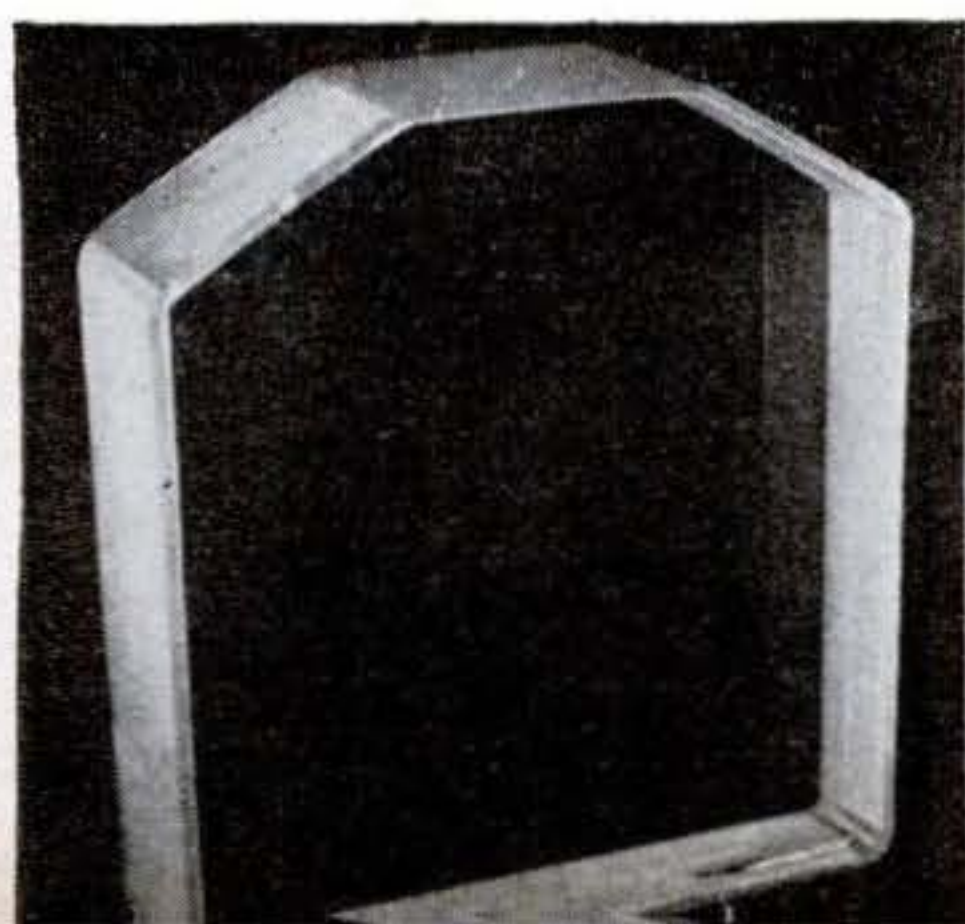


This high-speed shot of a flying bullet was made on the range, diagrammed below, of the Pittsburgh Plate Glass Co., where "bullet-tumbling" effects of various types of glass are tested



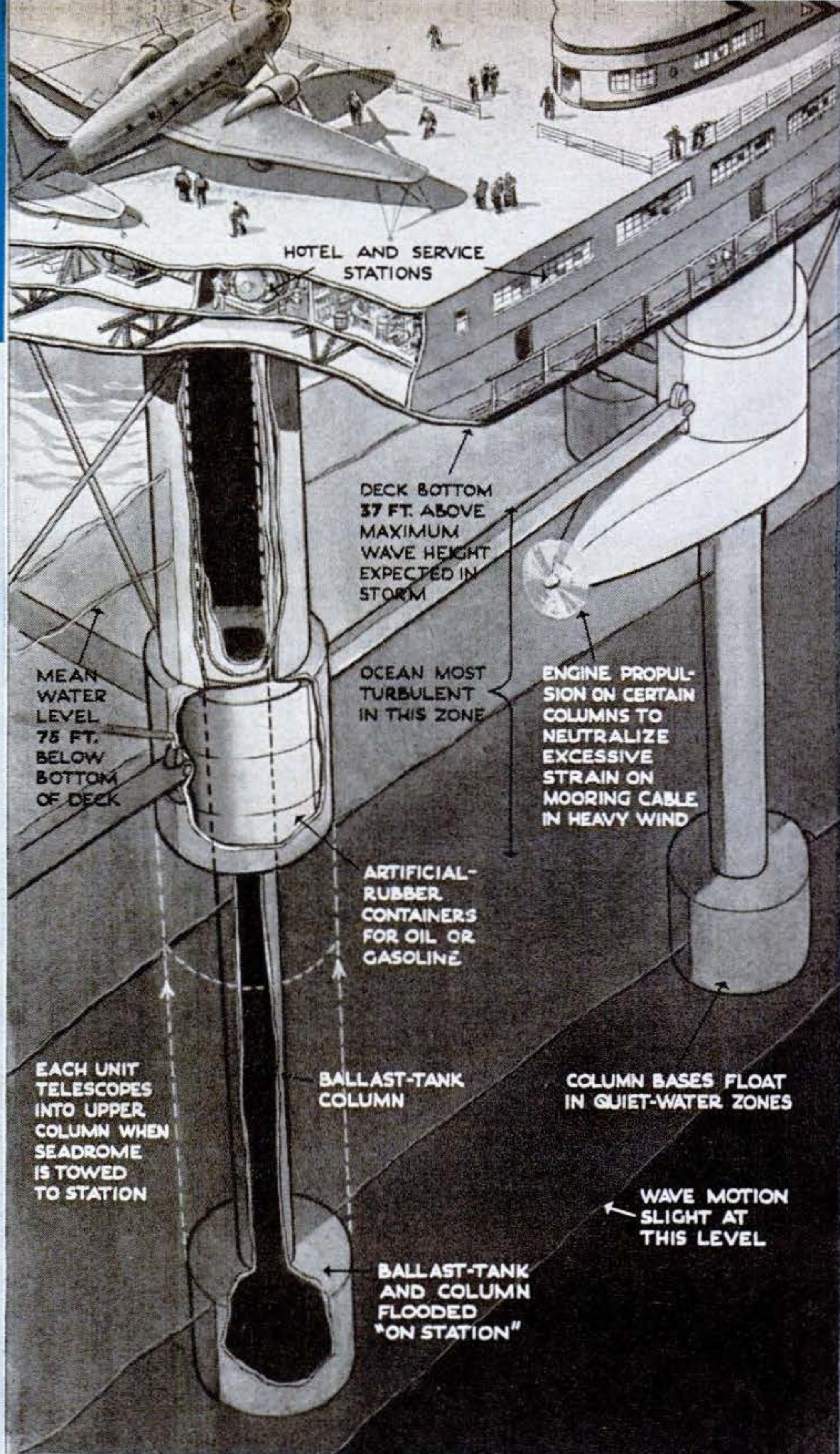
THREE-INCH GLASS, (shown at left) is used in bombers. Right, the same glass after being hit with a .50 caliber bullet fired from 50 yards at a 60-degree angle. The glass broke—but the bullet didn't get through. A 1½-inch-thick glass

(at left, below) will stop the bullet of the .30 caliber cartridge shown beside it, fired from 50 yards at 45-degree angle. Three-inch glass (right) stops .50 caliber

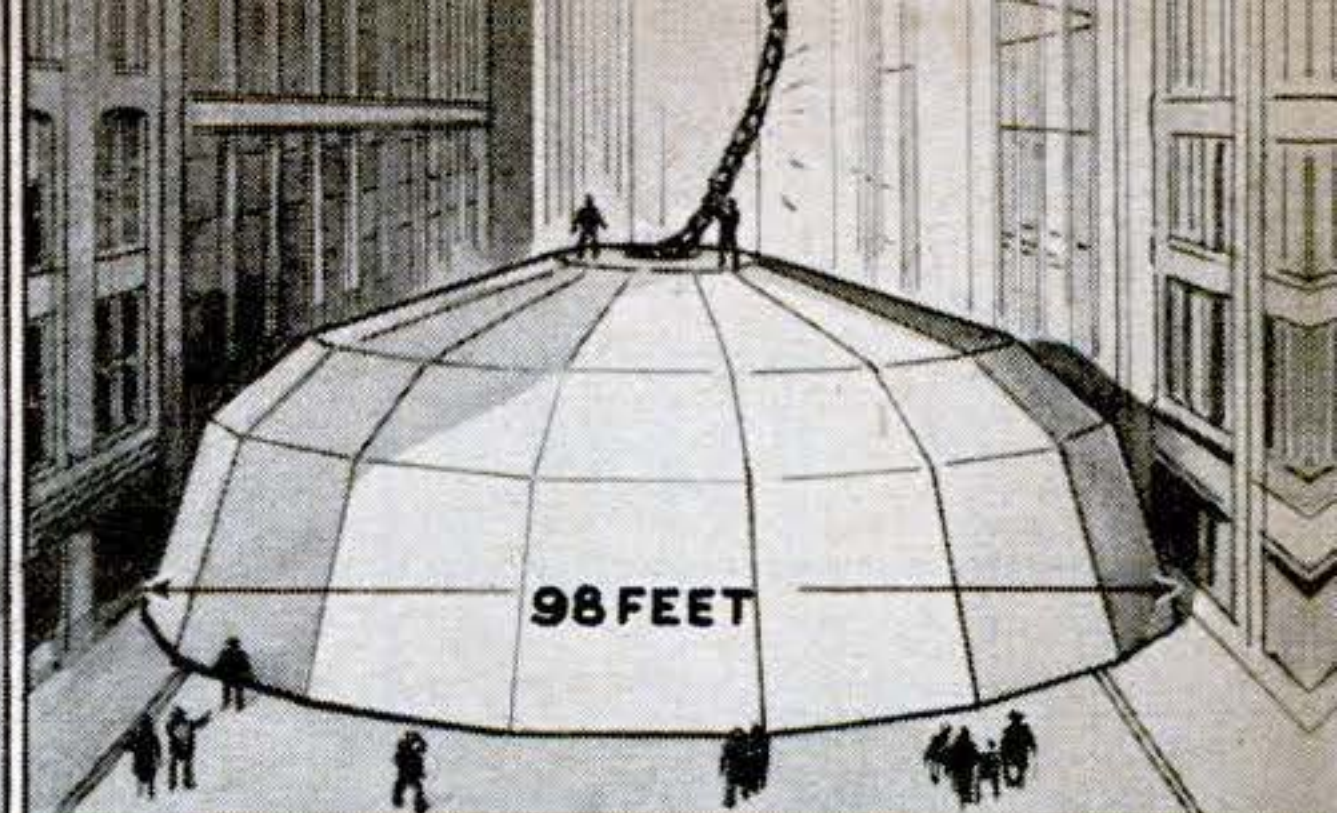
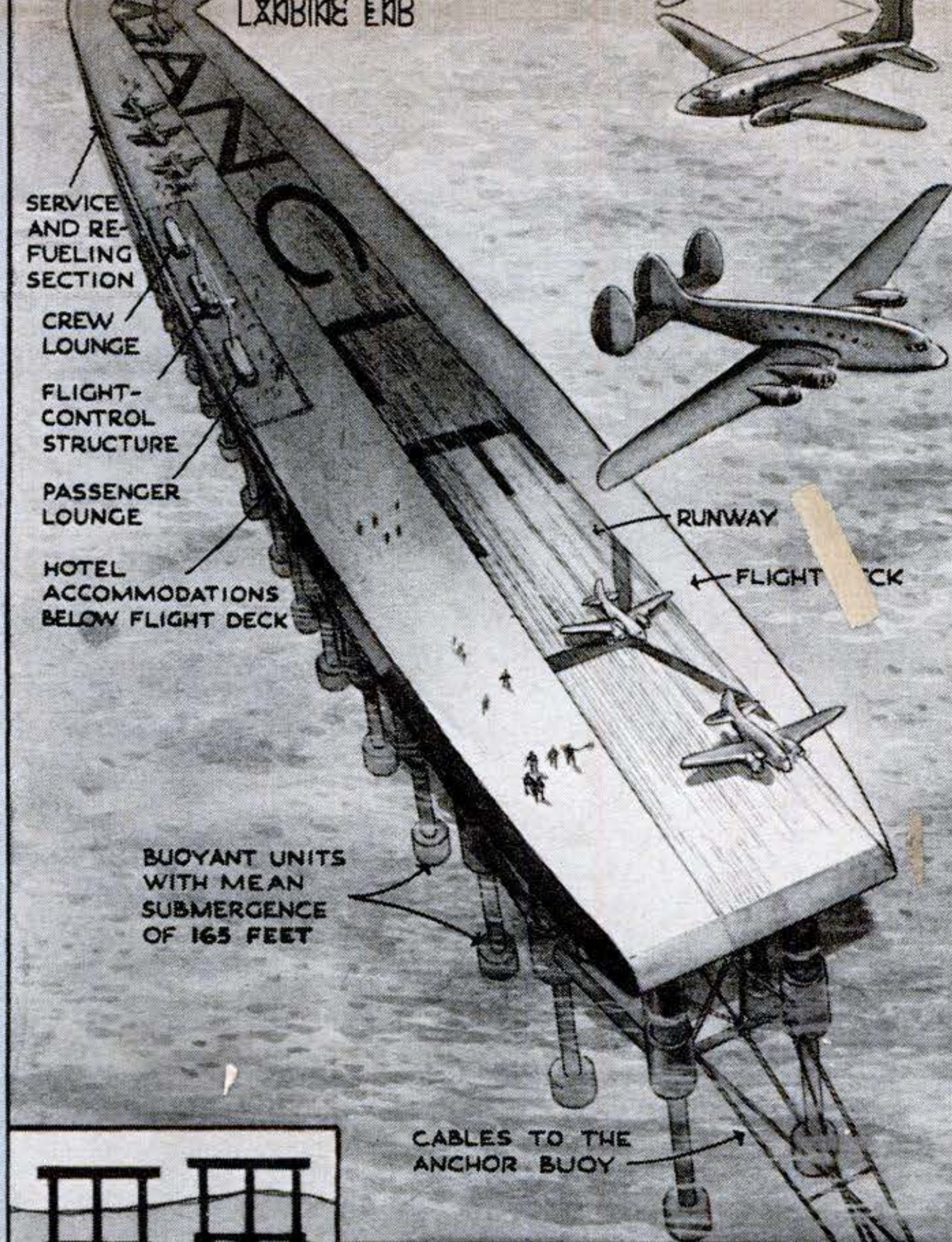


SEADROME DESIGN IMPROVED

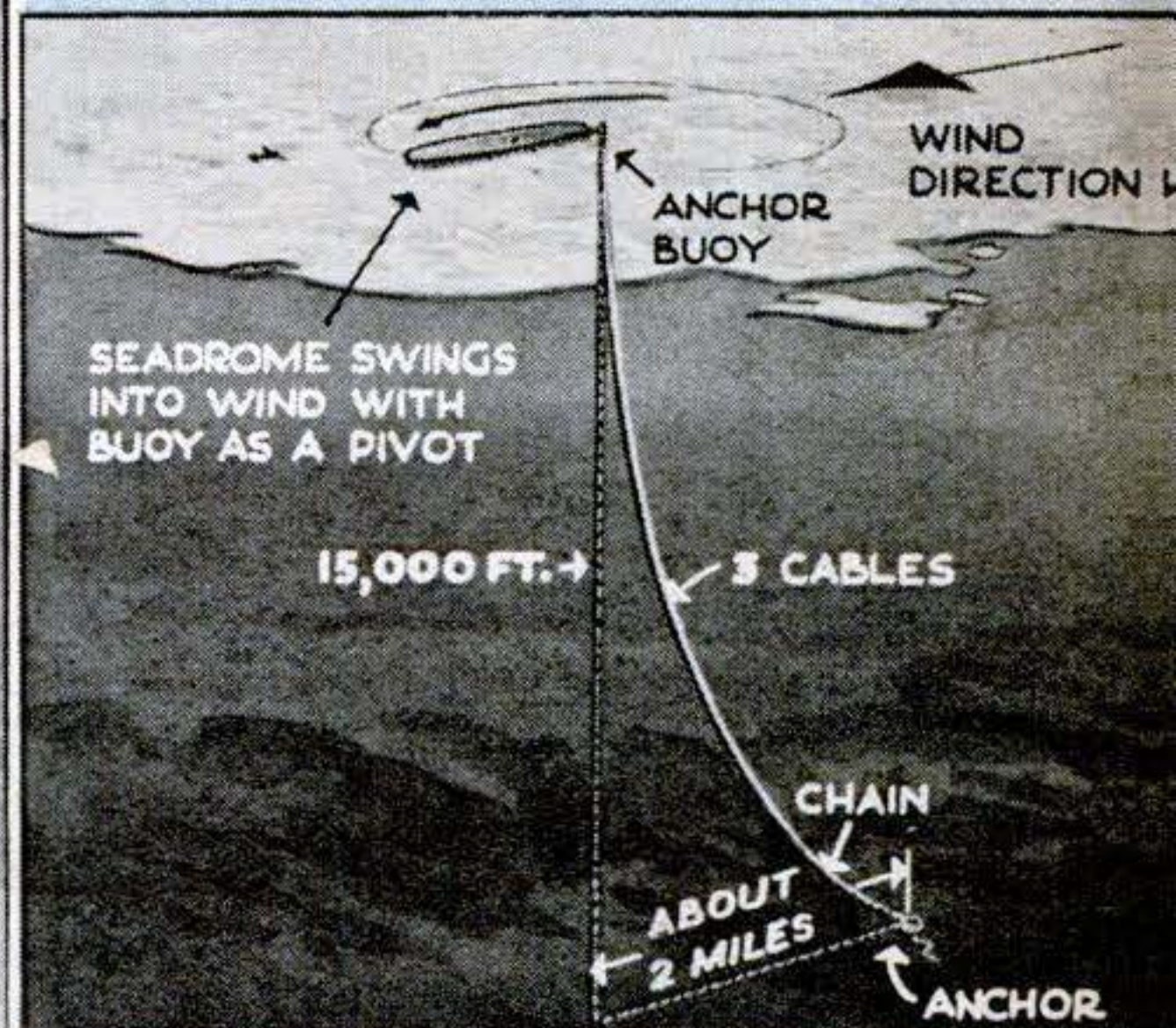
MODIFICATIONS in the design for postwar construction by Pennsylvania-Central Airlines of floating airports (P.S.M., Sept. '43, p. 81), which will dot the Atlantic to facilitate air travel between the east coast of the United States and European and African ports, have been announced by the designer of the seadromes, Edward R. Armstrong, of Philadelphia. Greater streamlining, both above and below the ocean's surface, will reduce air and water resistance and thus relieve tension on the airport's anchor cable. The flight deck will be slightly corrugated for better traction, and will carry counter-sunk lights to guide planes in night landings. There will also be less superstructure than was formerly planned, with most of the airport's housing sections placed below the flight deck. Another innovation will be the use of parts of the supports for storing oil, gasoline, and water. The airports will be 3,550 feet long and 400 feet wide, with only 150 feet of the width being used for the runway. Each seadrome will cost \$10,000,000 and will be named after one of the pioneers in the development of aviation.



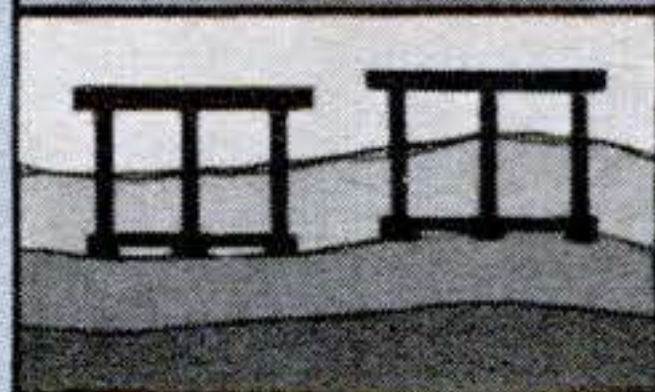
EARLY SCULPTURE. This 20-ton basalt head was unearthed near La Venta, Tabasco, Mexico, by the National Geographic Society—Smithsonian Institution Archeological Expedition. Dr. Matthew W. Stirling (left), leader of the expedition, points out details of the head to Dr. Gilbert Grosvenor, president of the Society (center), and Dr. Alexander Wetmore, assistant secretary of the Smithsonian. The head is believed to have been carved about 1,300 years ago and to have been used in religious rites. It is now on exhibit in Washington, D. C.



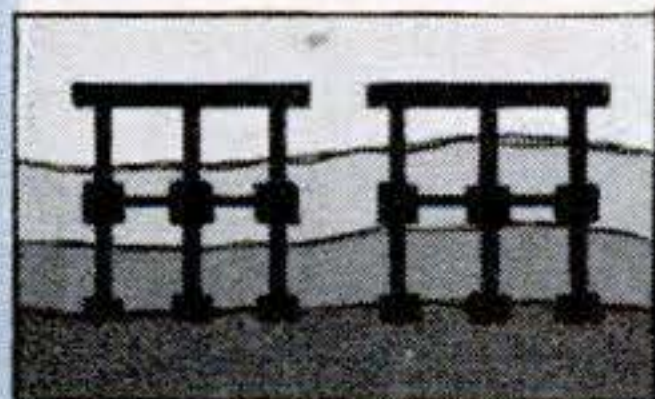
How one of the 1,500-ton anchors would appear if it were placed in a city street



Each seadrome will swing from a buoy held by cables to an anchor on the ocean bottom



On short supports, airport would rise and fall with waves



Supports that reach to stable-water levels are required to hold airport steady



Airports will be spotted across the Atlantic at intervals of between 575 and 1,200 miles. Being able to refuel at each stop, planes will carry less gas and much greater passenger and freight payloads. Rates for the fastest crossings are expected to be six cents a mile

A FISH PIPELINE that sucks up a ton and a quarter of fish per minute from the hold of a boat is being used to bring ashore the catches made by the sardine fleet operating out of Portland, Me. An eight-inch hose takes the fish from the hold, which is flooded with water to prevent damage to the catch. A 12-inch hose then carries the sardines into the cannery, a screen separating water and fish just before they reach the bins. This new method, invented by John D. Toft, is said to have speeded up the unloading of the boats by 600 percent.

FEBRUARY, 1944



Popular Science Contest Uncovers

1001

Postwar Jobs for the Jeep

More than a third of entrants favor keeping 'em down on the farm . . . Other suggestions range from forest-fire fighting to conversion as a snappy sports car . . . Most soldiers are opposed to "prettying them up."

FIRST PRIZE, \$100

R. W. Radelet, Vancouver, B. C., Canada

SECOND PRIZE, \$50

Pvt. Ronald E. Doan, Camp Sibert, Ala.

THIRD PRIZE, \$25

S. M. Farmer, Chestertown, N. Y.

EIGHT PRIZES OF \$5

Tommy Bransford, Lonoke, Ark.; Lt. W. L. Hoffman, Camp Forrest, Tenn.; Miles E. Hoisington, Detroit, Mich.; Pfc. Robert W. Huzzard, Wright Field, Dayton, Ohio; Joseph Krucher, New York, N. Y.; Ernest Prete, Staten Island, N. Y.; Ray Ring, Framingham, Mass.; N. Spector, Waco, Tex.

HONORABLE MENTION

Mrs. Erol W. Bowie, Northampton, Mass.; Nathan Bridwell, Midland, Ind.; Lt. David F. Brinegar, Camp Tyson, Tenn.; Miss Carolyn Crawford, Dallas, Tex.; Pvt. Stanley Hayman, Bolling Field, Washington, D. C.; Thomas K. Hendryx, Pittsburgh, Pa.; Hugh G. Jennings, St. Louis, Mo.; J. T. Lancaster, Hamilton, Ont., Canada; Joseph A. Reif, Philadelphia, Pa.; Pfc. A. W. Swahlen, Atlanta, Ga.; C. J. Williams, Harrison, Tenn.

OUR little wonder warrior, the American jeep, which has won unbounded admiration by its performance on fighting fronts and behind them in every quarter of the globe, is not going to have any difficulty in finding employment after the war.

This was made clear by the flood of ideas submitted in our contest (announced P.S.M., Aug. '43, p. 101), for the best suggestions on peacetime jobs for the sturdy, overpowered little machine. And, judging from the letters submitted by contestants, the jeep's reward for its part in winning the war is likely to be, for the most part, a lifetime of hard work down on the farm.

Out of almost 1,200 persons who entered the contest, more than 400, including the winner of the first prize, thought the proper postwar place for the jeep was the farm, where its chores would take in about everything now performed by man, beast, and machine, from plowing to harvesting—and then on to marketing.

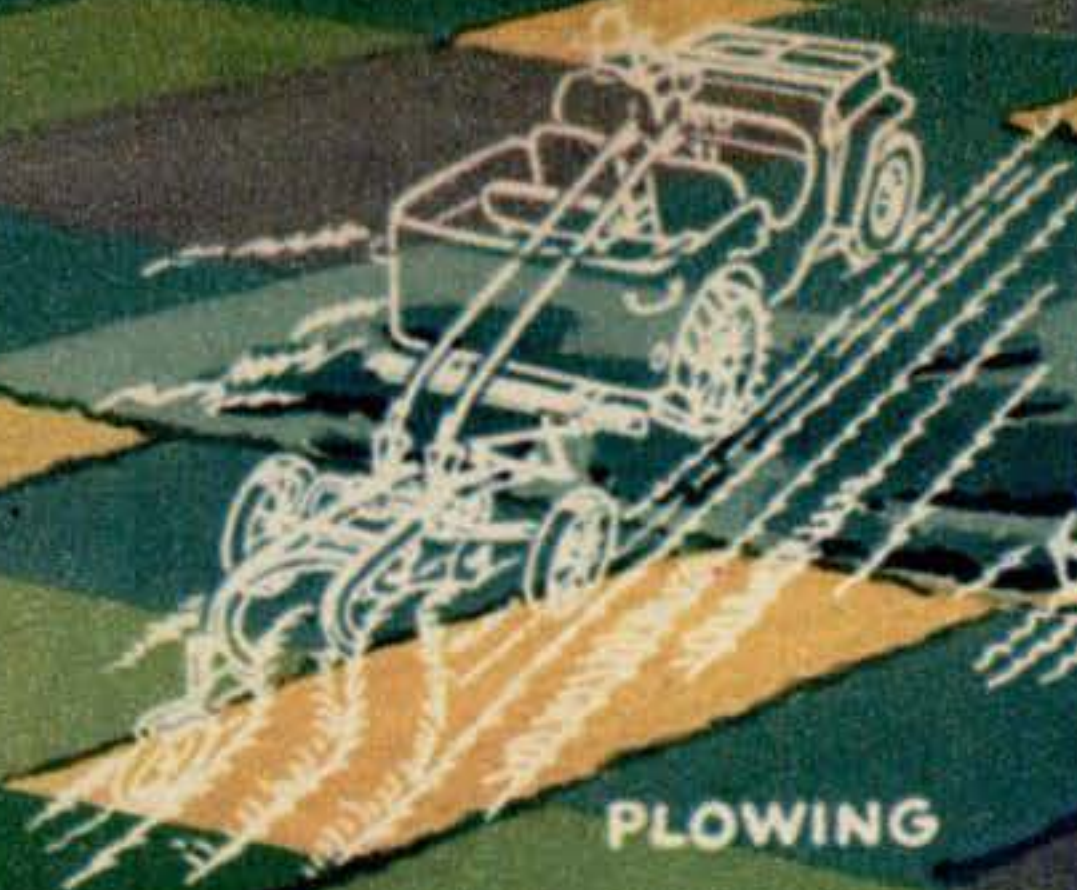
Letters came from every section of this country, as well as from Alaska, Canada, Cuba, and South America. Many came from men in the armed services, who spoke of the jeep not only with pride but with affection. Scores of contestants cleverly illustrated their suggestions. A few turned to verse to express their ideas, and one ingenious entrant even worked out an acrostic to boost the jeep's potentialities. So numerous and so meritorious were the ideas submitted that POPULAR SCIENCE increased the number of prizes from eight to 11 and included 11 honorable mentions.

Jobs were found for the jeep not only in the fields but in the forest and the factory, on city streets and on the cattle range, in railroad and highway construction camps, at airports, on golf courses and race tracks, on college campuses, and on backwoods roads leading to favorite fishing waters.

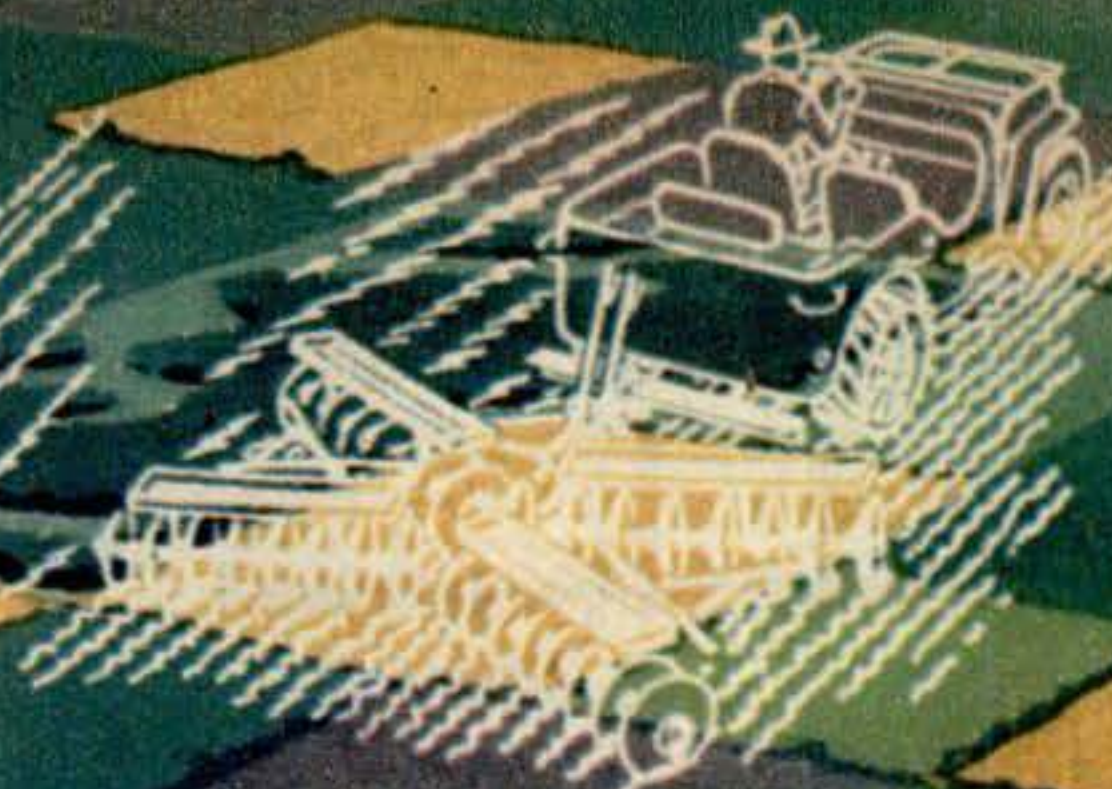
It was assigned to postmen and doctors in rural districts, to road surveyors and inspectors, to electric-power workers, to telephone and telegraph wire stringers, and to a wide variety of construction, maintenance, and repair jobs. Some suggested it be turned into an ambulance, for service not only in poorly developed sections of this country, but also in China, India, and Africa, where it would help to carry on the work of American humanitarianism.

Many saw the peacetime jeep as an aid in the protection of life and property. These assigned it to police duty—local, state, and F.B.I.—and fire fighting, particularly in the forests. More

First prize winner R. W. Radelet foresees a busy career for the jeep as a machine-of-all-work for the small farmer who cannot afford to own a large number of powered implements. He would have the vehicles sold through mail-order houses, which would also offer a complete range of attachments for farm work



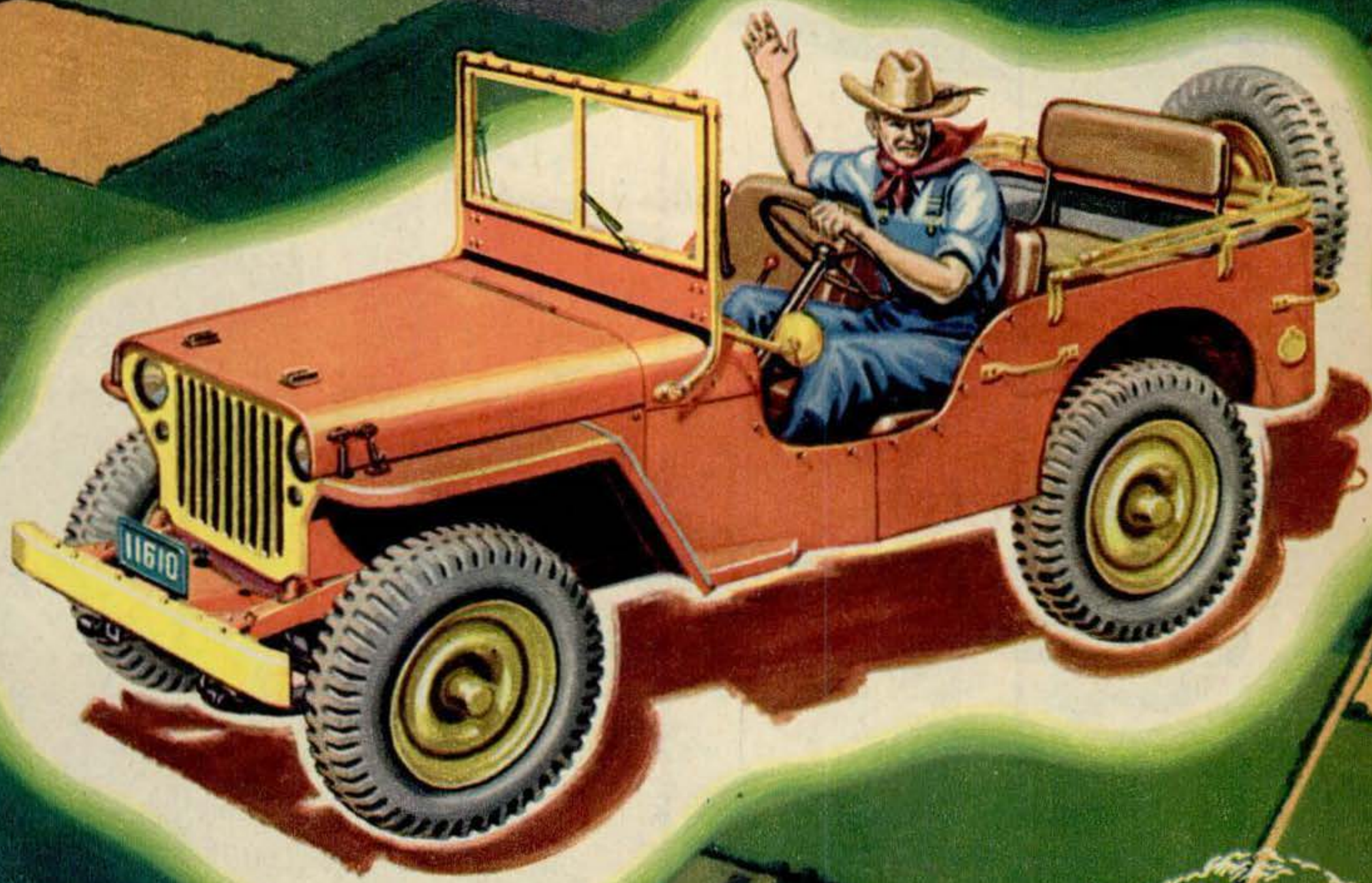
PLOWING



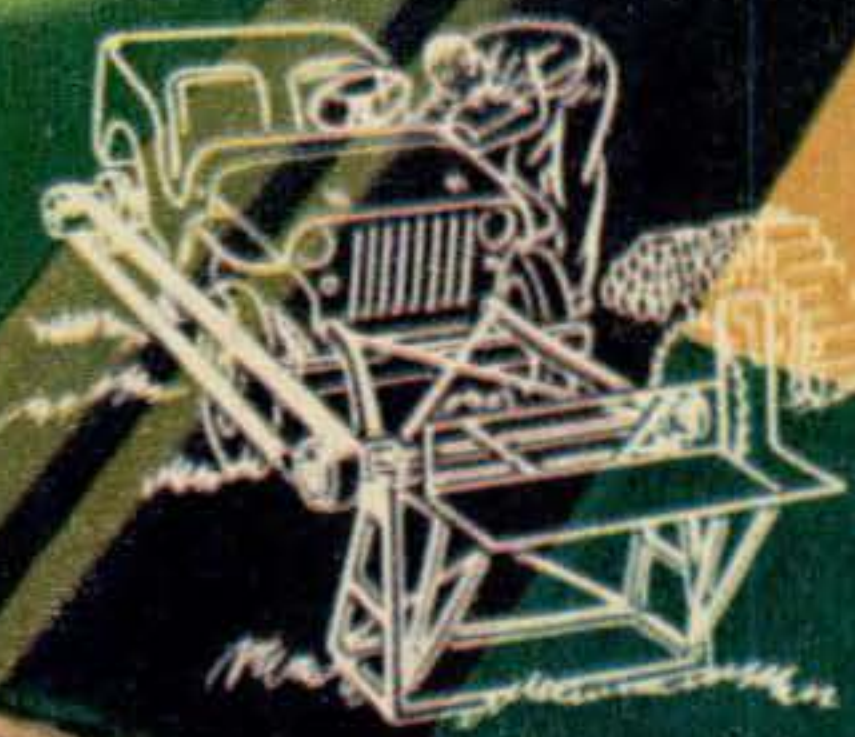
DISK HARROWING



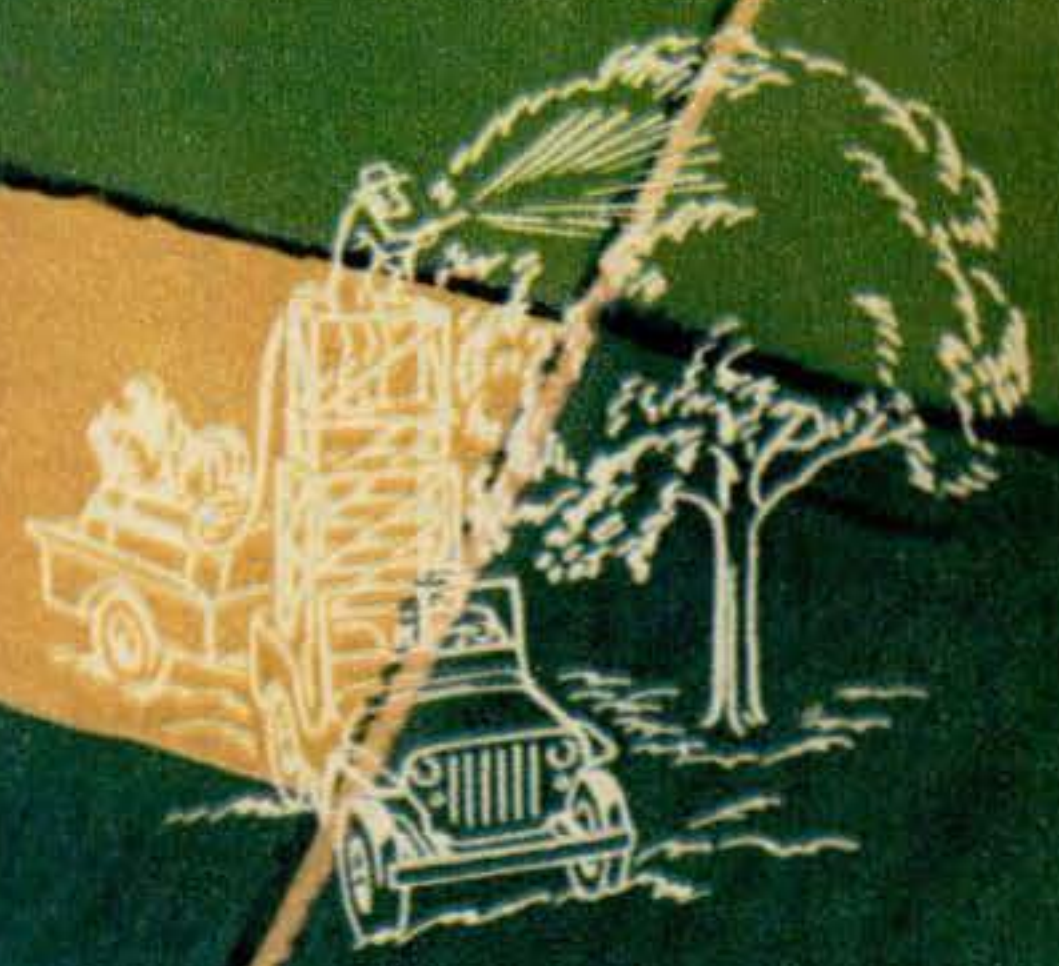
RAKING HAY



POWER MOWING MACHINE



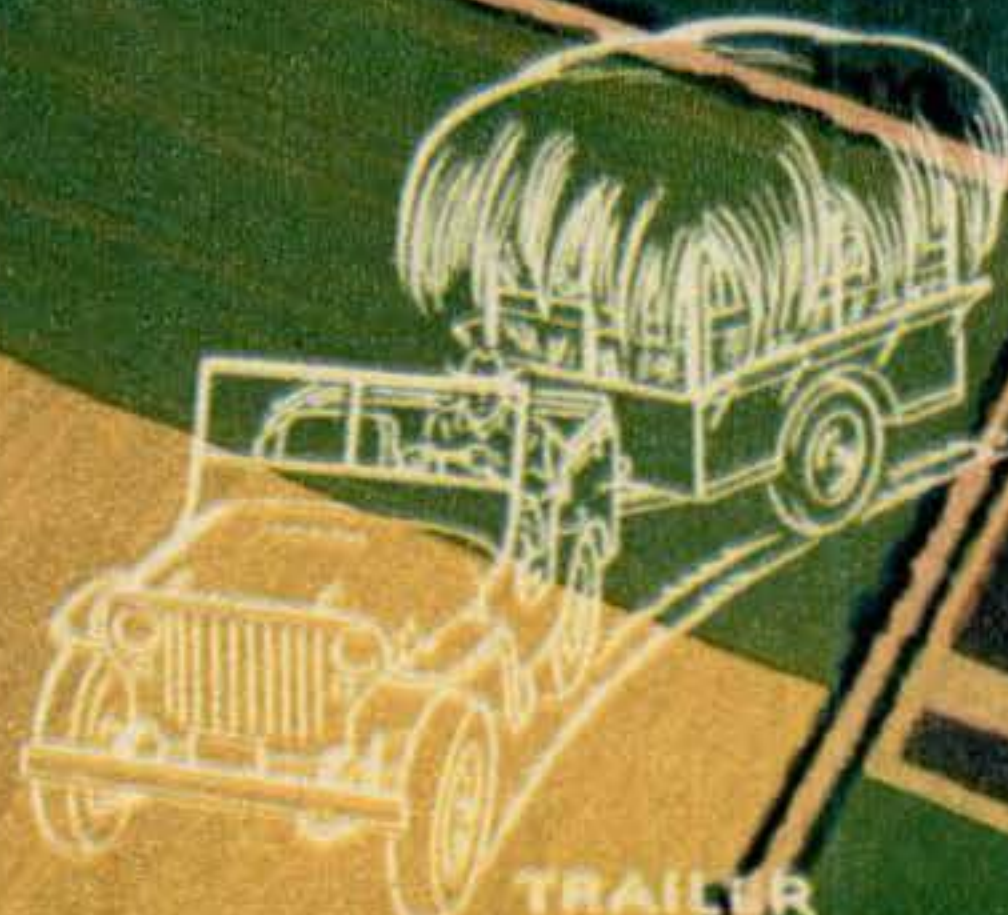
CONVENIENT PULLEY POWER



EXTENSION PLATFORM FOR
FRUIT SPRAYING & PICKING



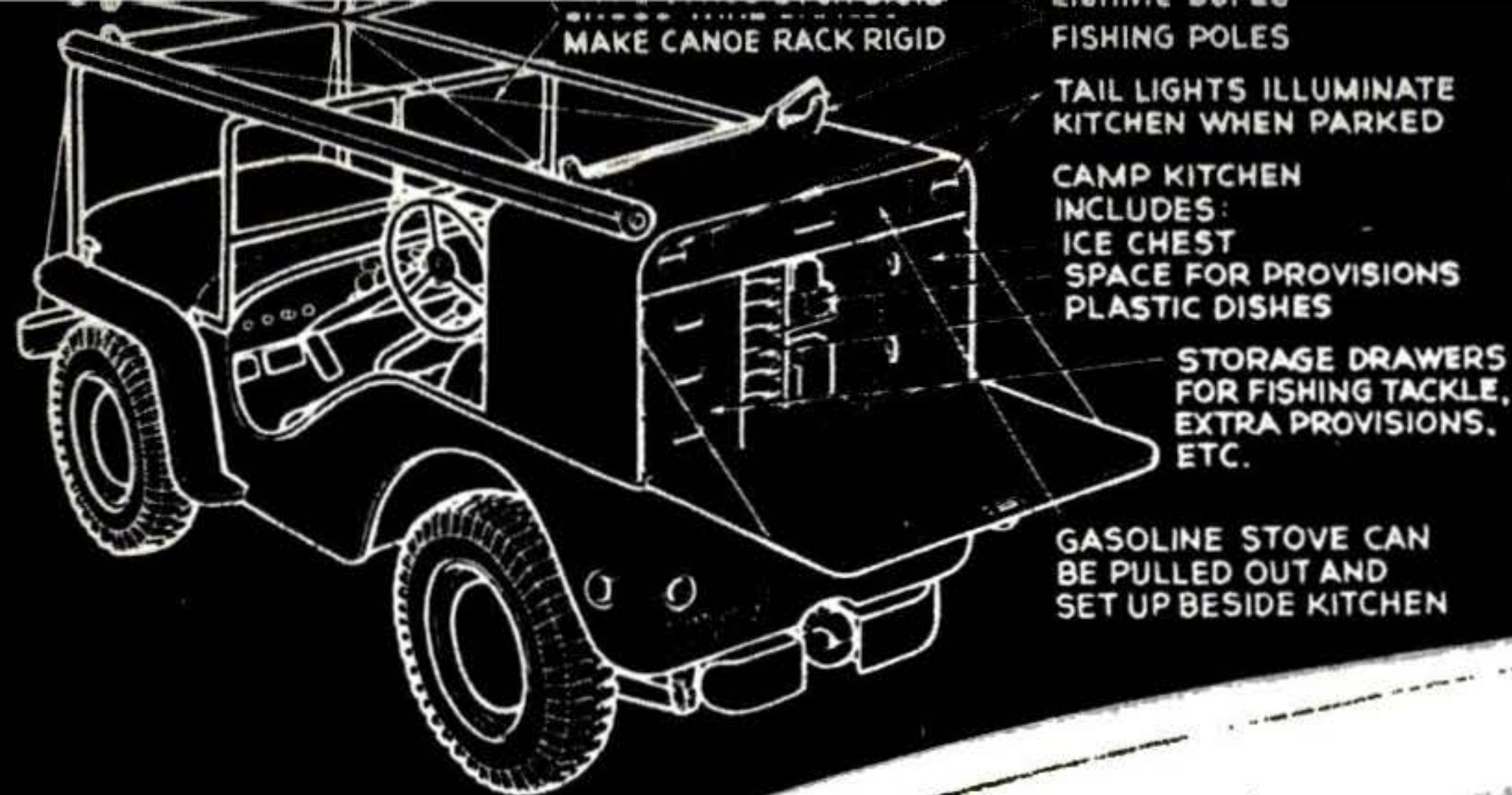
LIGHT DELIVERY TRUCK



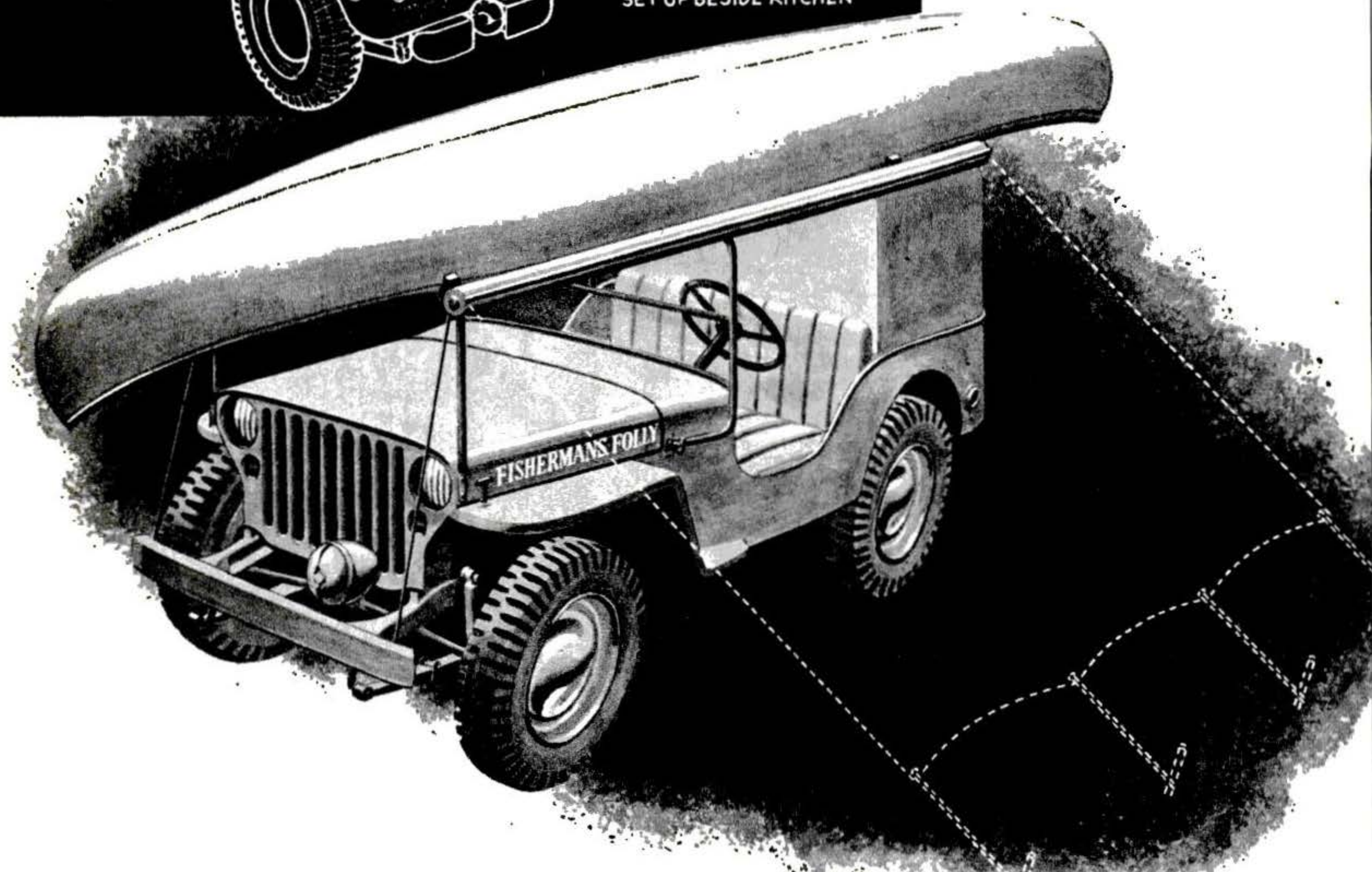
TRAILER



PERSONNEL TRANSPORT



Visions of peacetime fishing trips inspired Private Doan's prize-winning idea. The "folly," he says, would carry anglers to unfished backwoods streams—with a canoe, built-in camp kitchen, and handy roller tent



than 200 suggested converting the machine to commercial uses, mostly as a light delivery truck, and into a pleasure car.

Some of the conversion ideas called for considerable alterations. An example of the imagination used in transforming a jeep into a sports car, disguised by streamlining and radiant in paint and plastics, is shown in an airbrush painting in full color submitted by Ray Ring, of Framingham, Mass., and reproduced on page 85.

Incidentally, the idea of prettying up the jeep to serve as a pleasure car drew cries of pain from servicemen. While most of them expressed hopes of owning a jeep after the war, many of them simply for the pleasure of driving it around, the servicemen wanted it to retain its present rugged homeliness. Lt. W. L. Hoffman, of Camp Forrest, Tenn., who was awarded a prize, voiced this opinion:

"In the service we all know and love the jeep (the one-quarter-ton truck to us). We've driven it and nursed it, cussed it and

blessed it. We know that it's the best car in the world—for the job it was meant to do; but to make a pleasure car out of it—*never!* That would be like dressing one of our tough old 'top-kicks' in diapers. The jeep was meant to do a man's job in rough country—not to take 'old women' to tea parties."

"But," he continued, "there are many jobs for jeeps in peacetime—jobs that are commensurate with its abilities. On the farm, for instance, they'll do anything a horse will do, except whinny—and you don't have to feed them when they're not working."

Lieutenant Hoffman's omnibus reference to the jeep's farm-work potentialities was amplified by the first-prize winner, R. W. Radelet, of Vancouver, B. C., who emphasized the value of the jeep to the small farm operator who can afford only a single machine. In such hands, he said, the jeep could be used in the orchard for spraying and picking. In the fields it could be used as a tractor with a gang plow, a mower,

and a rake. It could also be used as a truck and a trailer car to haul produce and stock. It could be employed as a stationary power plant, and it could carry workers to and from the farm.

A soldier with his mind on the pleasures of peace won second prize with an idea to adapt the jeep to a "fisherman's folly." A rack on top could carry a canoe, and the back seat could be converted into a camp kitchen, with ice chest, plastic dishes, storage drawers for fishing tackle and provisions, and a gasoline stove. Rollers at the sides would enable the lowering of canvas to make the jeep a shelter. The soldier, Pvt. Ronald E. Doan, of Camp Sibert, Ala., suggested that all the attachments could be sold as a unit, to be installed by a local mechanic.

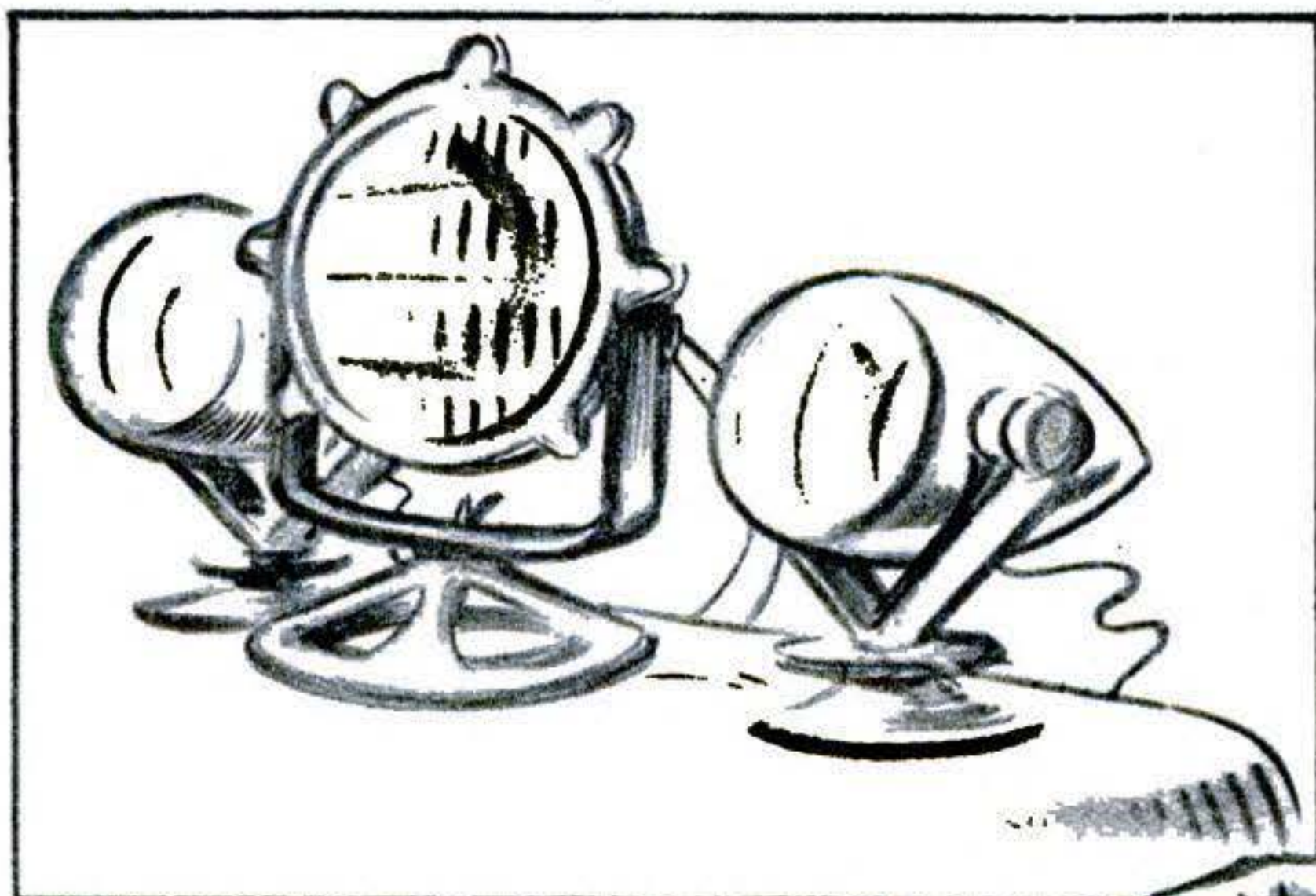
"The 'folly's' four-wheel drive," he wrote, "would pull it farther into the backwoods and nearer to unfished streams than any pleasure car would dare to venture. Upon arriving at your selected spot, pull down the roller tent, open up the kitchen, and there's



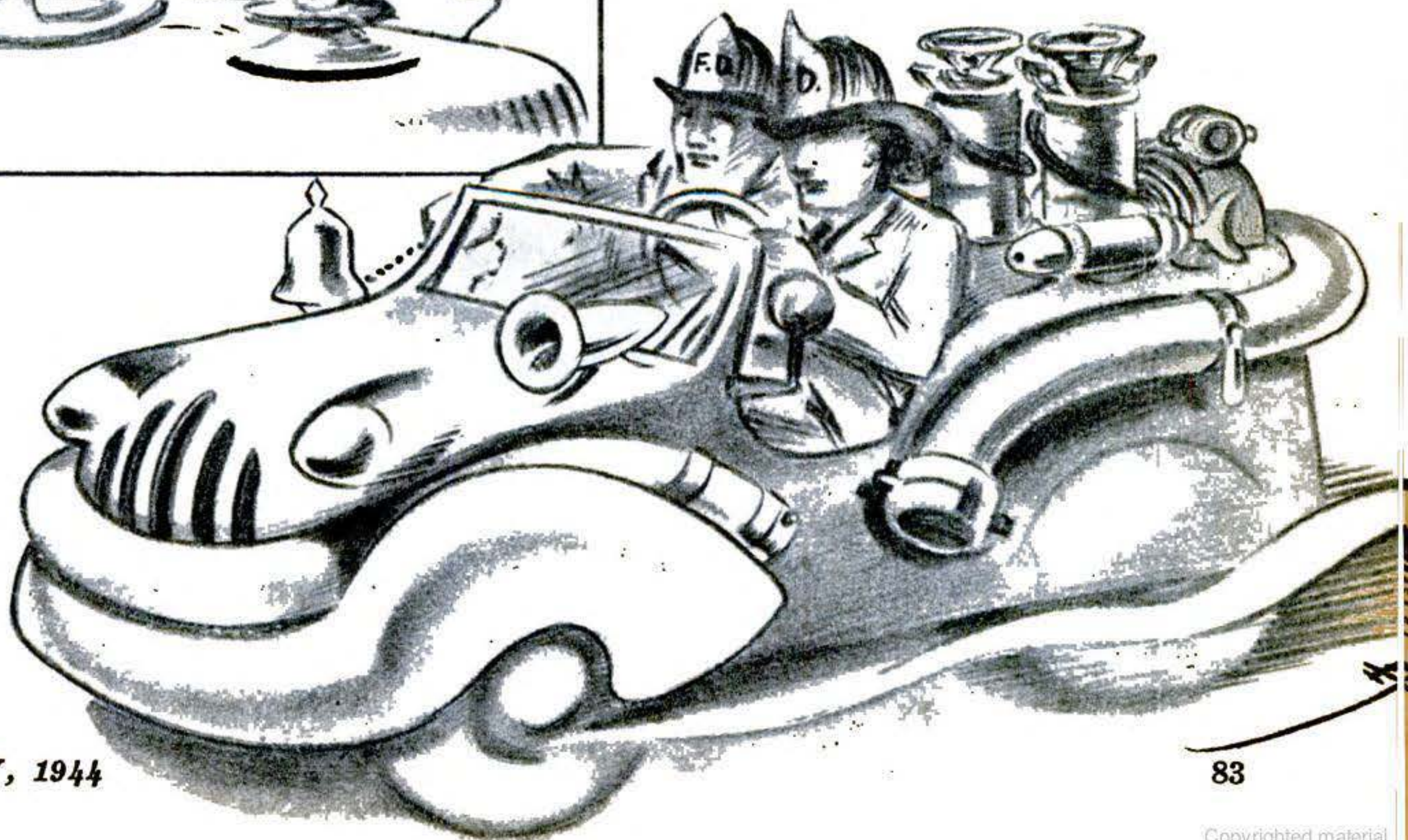
Pfc. H. E. Draft and his buddies at Fort George Wright, Wash., made a convertible coupe of their air-conditioned jeep, by the addition of a removable plywood cab. Accessories include radio and ash trays

your camp—deluxe and Dad's delight."

The winner of the third prize, S. M. Farmer, of Chestertown, N. Y., envisioned a dozen uses for the peacetime jeep, the first of which was to transport men and equipment to forest fires in remote areas, where its ability to travel over logging and tote roads gives it a big edge over regular cars and trucks. This same ability, he said, would make the jeep useful to logging companies, in hauling supplies by trailer. He also suggested that the jeep be used to carry doctors, police, and border patrols



This drawing, submitted by Joseph Krucher, of New York, N. Y., illustrates his idea of the jeep as a speedy, maneuverable hose cart that could dash to the scene of a fire and have hose lines laid and attached to hydrants before the heavy pumpers arrived



over roads choked with snow or mud, that it be used on farms as a tractor and a pick-up, and that it supplement riding horses at summer hotels, which could rent jeeps to guests to tour the surrounding country.

Among ideas for converting the jeep into a forest-fire truck was the prize-winning entry of Ernest Prete, of Staten Island, N. Y. He proposed that the jeeps be covered with a thick asbestos shell and equipped with a revolving turret with two nozzles, "which would shoot water the same as the turret guns on an airplane shoot bullets." A sprinkling device attached below the front of the radiator would spray ground fire. Water for the apparatus, when not available from streams or lakes, would be drawn from a tank car towed by the transformed jeep.

Joseph Krucher, of New York City, also won a prize for his suggestion that the jeep be turned into a hose cart for city and rural fire departments. With its speed and maneuverability, it could race through traffic and have the lines attached to hydrants and ready for action by the time the heavy pumpers arrive. He also suggested that fire departments use the machine as a searchlight unit.

One of the most interesting letters was submitted by Tommy Bransford, 16 years old, of Lonoke, Ark. His letter, which contained an even dozen ideas, was awarded a prize. Farmers, rural doctors, mailmen, forest rangers, sportsmen, service-station operators, and cowboys "riding the fence"—to inspect it for breaks—were among his potential users of the peacetime jeep.

In his suggestion that the jeep would

be ideal for hunting and fishing trips, Tommy considerably thought of the women folks. With a converted jeep, he explained, a man "could go without worrying about taking the 'good' car away from his wife, who hates to have old fishing smells in it for months after one of his trips."

A considerable number of contestants brought up the point of how the Government would dispose of the jeeps. Some took it for granted that they would be sold in huge lots to manufacturers and dealers. But this disposal method was vigorously opposed by others, who saw in it a threat to the new-car market after the war. One of these, Pfc. Robert W. Huzzard, Army Air Forces, Wright Field, Dayton, Ohio, won a prize by suggesting that the jeeps be converted into ambulances and given to the American Red Cross for work in the Orient and Africa. The drawing which accompanied his entry is reproduced below.

Another opponent of putting jeeps on the open market was Edwin T. Brown, of Wilkensburg, Pa., who urged that we give the jeeps to our Allies or "bury them where they are" when peace is attained. He advised manufacturers to scrap their dies after the war and go on with the building of the automobiles of the future. Consigning peacetime jeeps to the category of toys, he declared: "We have to get on with the building of helicopters."

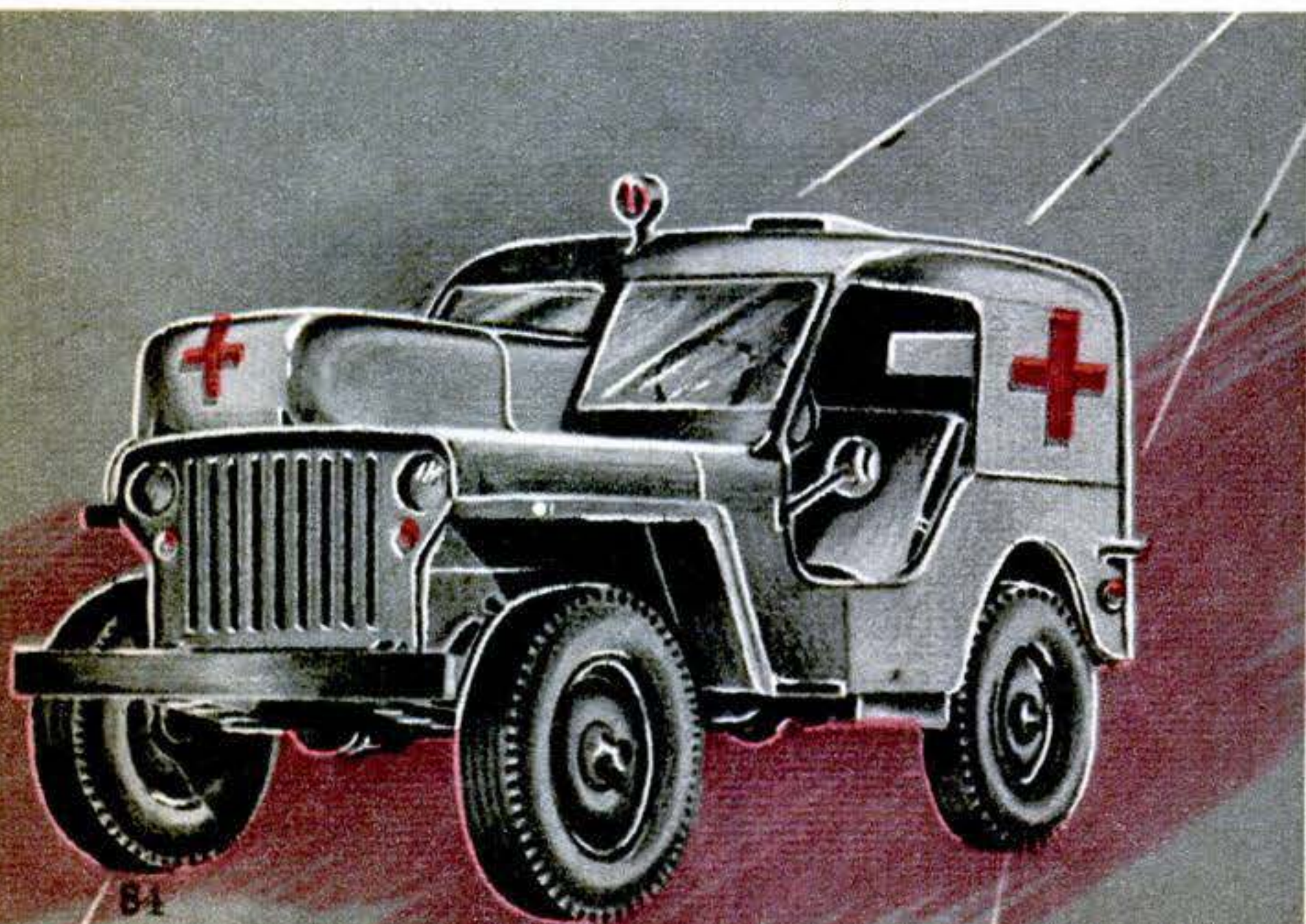
Perhaps a partial answer to this argument was contained in the suggestions that peacetime jeeps be used to haul the great planes of the future onto and off the landing fields, and to shuttle material and men around aircraft and automobile factories.

Other contestants believe the jeeps should be sold or rented by the Government directly to the persons who would use them. Pfc. Ralph R. Brown, in a V-mail from overseas, suggested that the Government establish depots at discharge points and sell or auction the jeeps to men leaving the service. Another serviceman proposed that a soldier be given his choice between a jeep and a bonus.

In a letter from Treasure Island, Calif., a U. S. Marine stated his wish simply:

"Like many another serviceman, I'd like to own one after the war—but no fancy paint, bright aluminum, white side walls, or brassy horn for me. You can put me in an order for one just as it is."

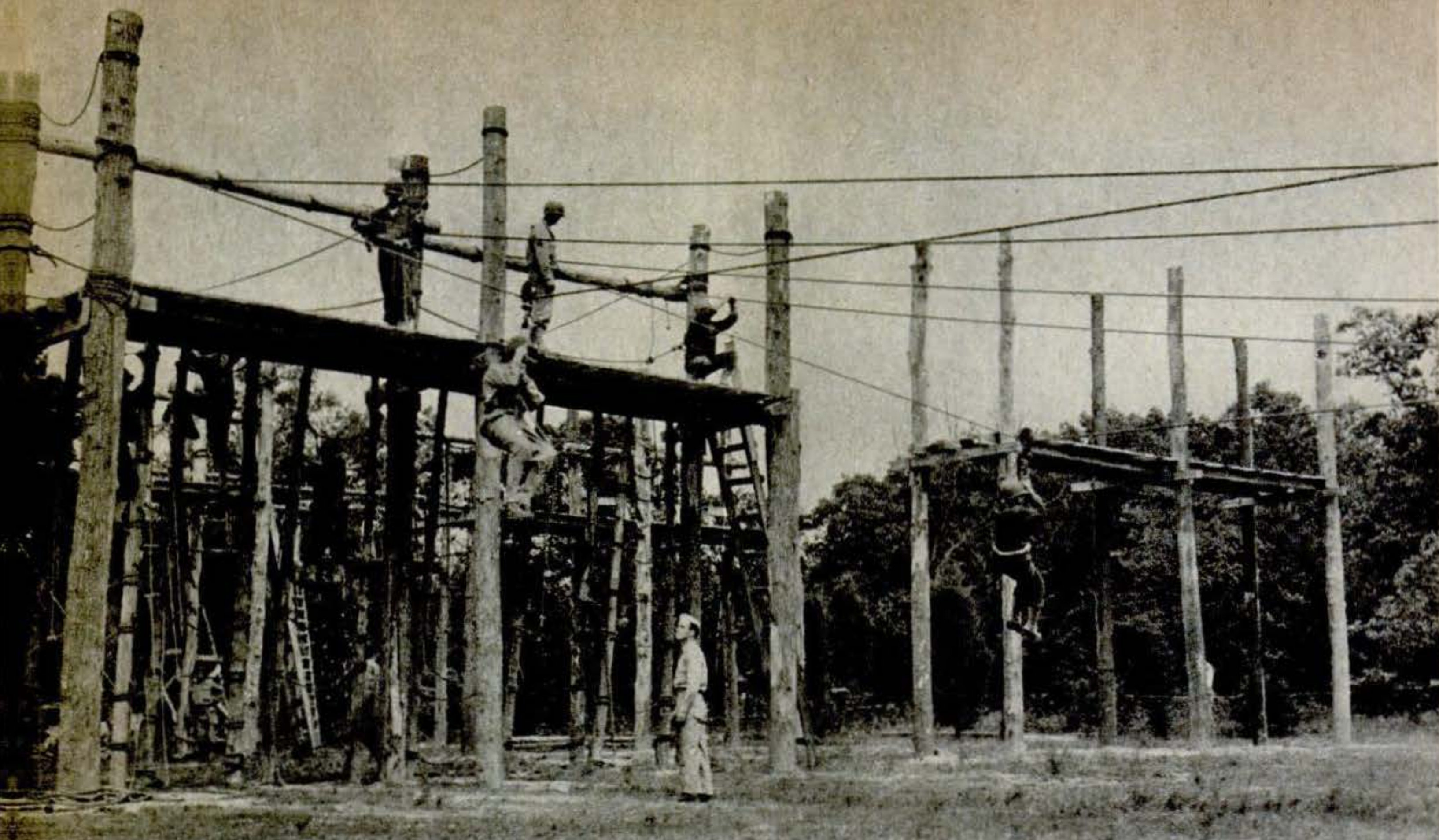
Pfc. Robert W. Huzzard, of the U. S. Army Air Forces, Wright Field, Dayton, Ohio, won a prize by suggesting that the quarters be converted into ambulances and given to the American Red Cross for use in postwar relief work in Africa and the Orient. His letter was accompanied by the drawing reproduced below





As a Sports Car

Contestant Ray Ring, who made this painting of a sports jeep, wants accessories manufacturers to sell racy-looking fenders; a convertible top with roof panel that folds forward with the windshield (1); a grille with removable plates to streamline headlights (2); combination stop light and strap buckle (3) to hold down folded top (4); and supplementary arched bumpers



GRADUATION exercises in the rope-rigging course at Fort Belvoir, Va., are vigorous, with trainees coasting down "the high line" in slings they have tied themselves. Slings are made of a bowline on a bight

Knot-Tying Obstacle Race

**ENGINEER SOLDIERS LEARN THE ROPES AT FORT BELVOIR
—AND RISK THEIR NECKS TO PROVE THEIR HANDIWORK**

KNOTS are as important to engineer soldiers as to sailors. Other soldiers' lives often depend on the engineers' ability to tie knots which will stay tied. At the Engineer Replacement Training Center, Fort Belvoir, Va., trainees are given 17 scheduled hours of instruction in knot-tying. If old-fashioned Army teaching methods were used, the subject would be boring, but Major I. J. Dalton, of the Pioneer Section, and Captain C. W. Kull, of the Rigging Subsection, have made it so interesting that the trainees devote much of their scanty spare time to study of the knot-tying art. High spot of the instruction is the trip that each trainee must take over the "knot obstacle course." This proficiency test is spiced with the elements of competition and physical hazard. "One bad knot," the boys say, "and you go down like hell!" The obstacle course consists of three 20-foot-high timber towers, which the trainees ascend and descend by means of rope ladders, slings, and other rigging devices made secure by knots which they tie themselves. Grand finale is a triumphant coast from the last tower to the ground in a bowline on a bight.

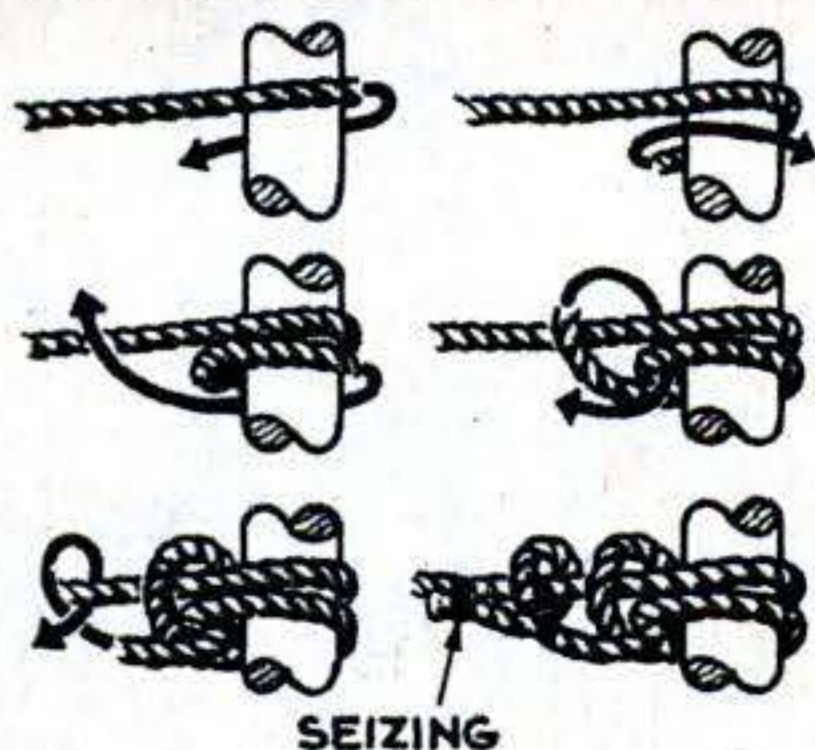
The clove hitch secures the rungs of a ladder as a trainee works his way up onto a tower. This knot tightens under strain, but can be easily cast off



THE ARMY'S 10 KNOTS ... AND HOW TO TIE THEM

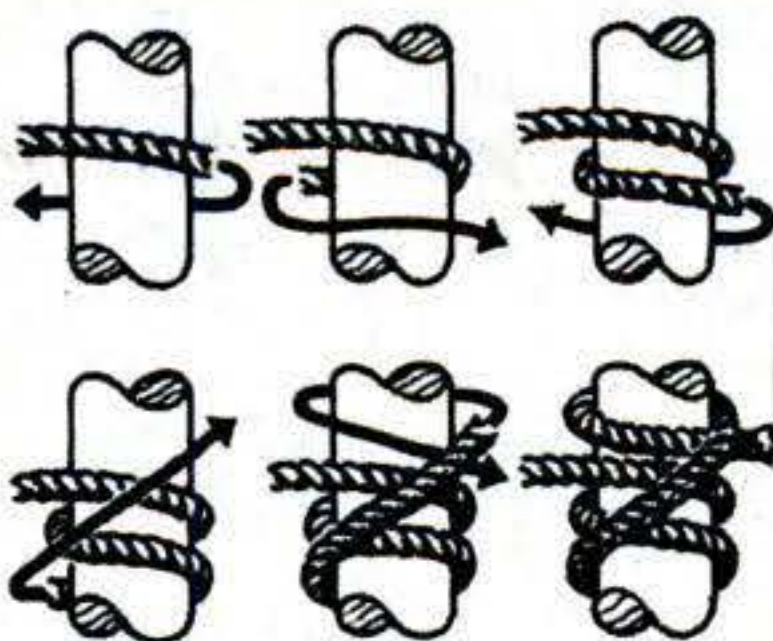
ANCHOR KNOT-

USED TO FASTEN A CABLE OR ROPE TO AN ANCHOR, OR FOR USE WHEN THERE WILL BE A SLACKING AND TIGHTENING MOTION ON THE ROPE



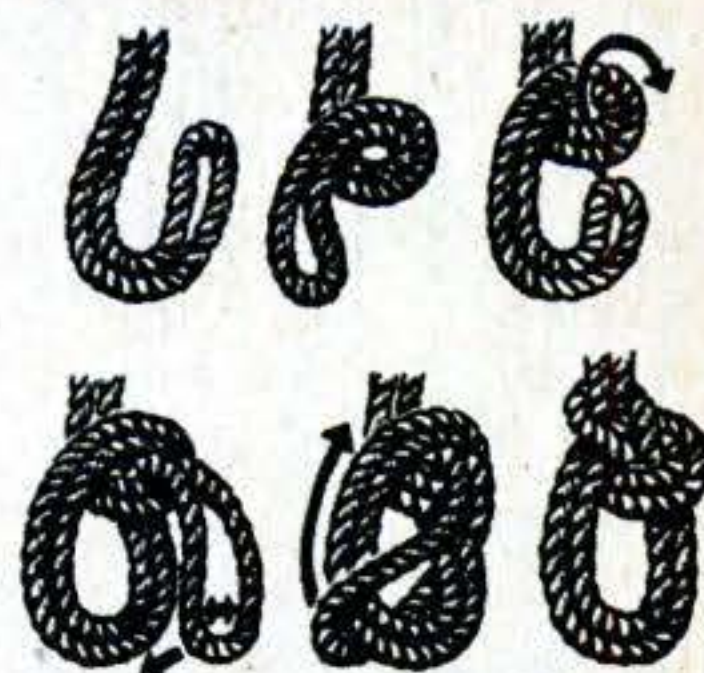
MOORING KNOT-

USED TO MAKE FAST A ROPE TO MOORING POST OR SNUBBING POST. PERMITS A LOAD TO BE EASED OFF WITHOUT LOSING CONTROL OF ROPE



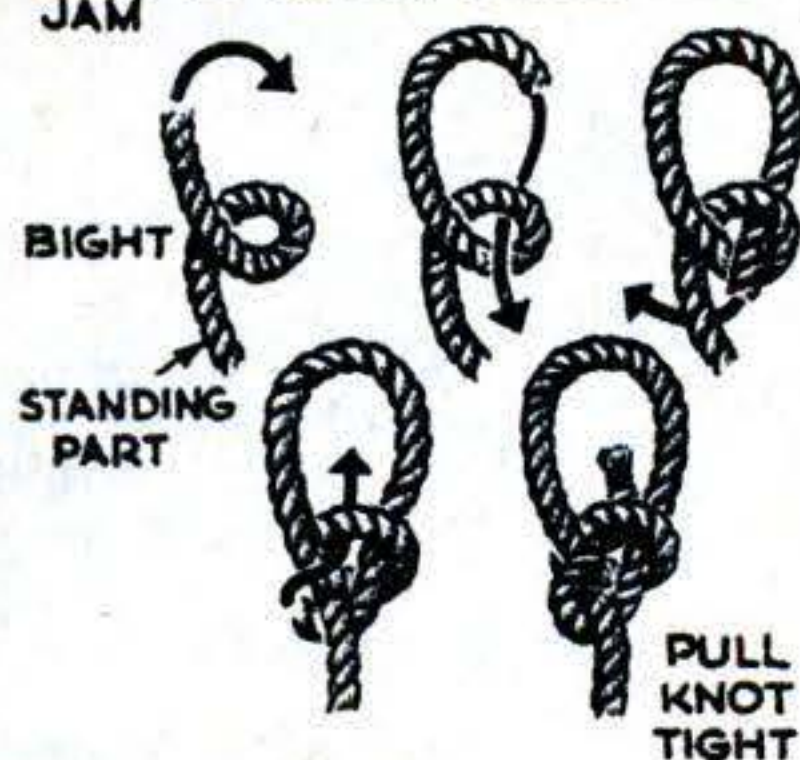
BOWLINE ON A BIGHT-

USED WHEN A DOUBLE LOOP OR SLING IS REQUIRED, AS IN A BOATSWAIN'S CHAIR. ALSO TO FORM A LOOP IN A ROPE WHEN ENDS ARE NOT AVAILABLE



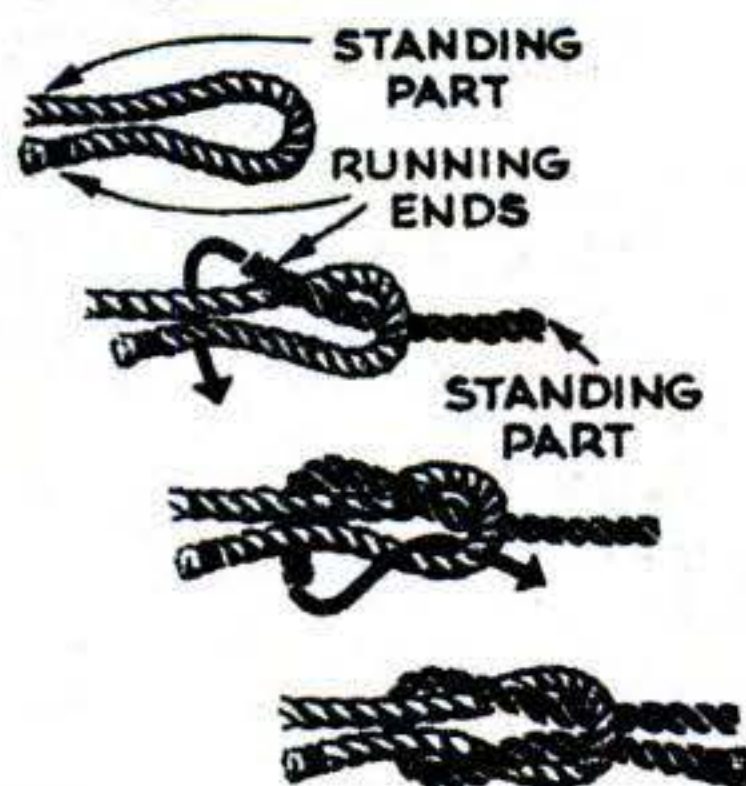
THE BOWLINE-

USED TO FORM A LOOP OF ANY DESIRED SIZE, THAT WILL NOT SLIP. EASY TO TIE AND UNTIE. WILL NOT JAM



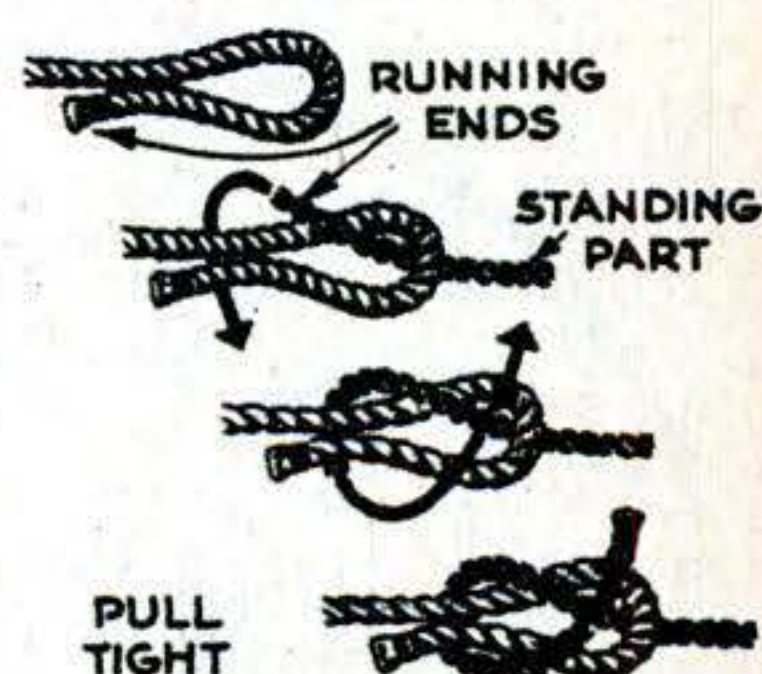
SQUARE KNOT-

USED TO JOIN TWO ROPES OF EQUAL SIZES



SINGLE SHEET BEND-

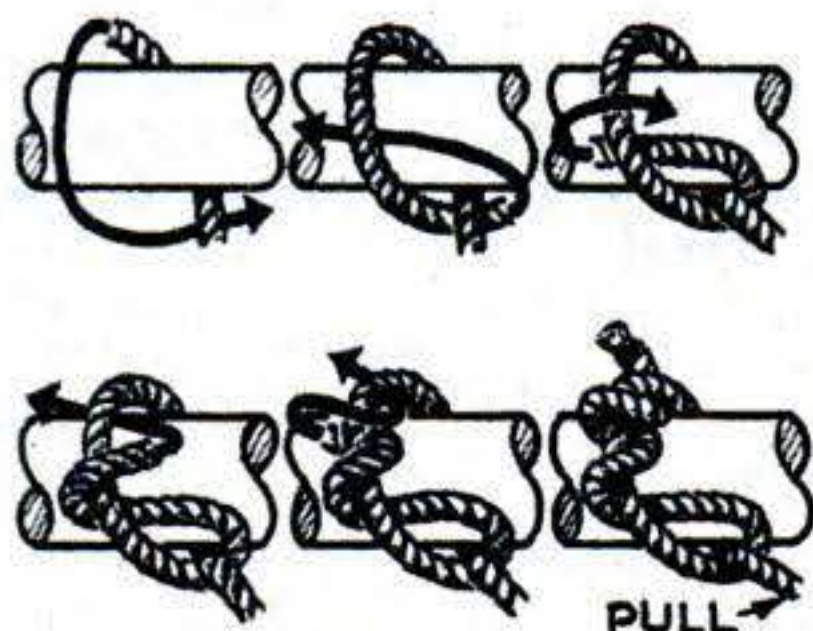
USED TO JOIN TWO ROPES OF DIFFERENT SIZES



NOTE-WHEN MAKING A SINGLE SHEET BEND, THE FIRST BIGHT SHOULD BE MADE WITH THE HEAVIER ROPE

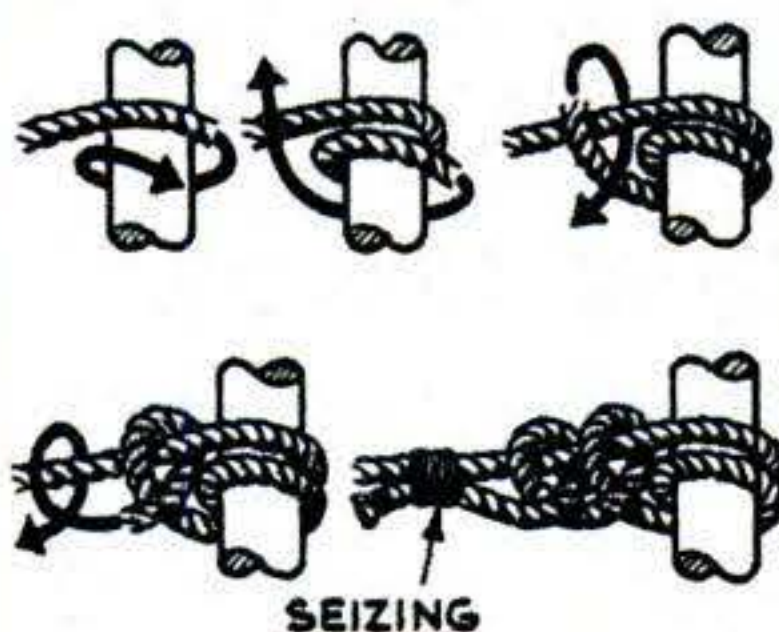
TIMBER HITCH-

USED TO HAUL LOGS, SPARS, OR ANY LONG, ROUND OBJECT WITH PULL PARALLEL TO OBJECT. TENSION SHOULD BE MAINTAINED AT ALL TIMES. EASY TO TIE AND UNTIE AND WILL NOT JAM



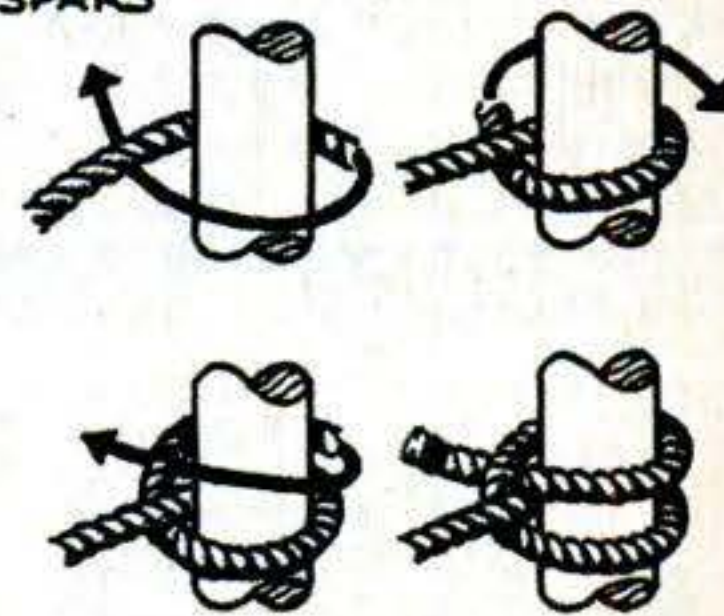
ROUND TURN AND TWO HALF HITCHES-

USED TO FASTEN A ROPE TO A SPAR OR OTHER OBJECT (FOR PERMANENCY, RUNNING END SHOULD BE SEIZED TO STANDING PART)



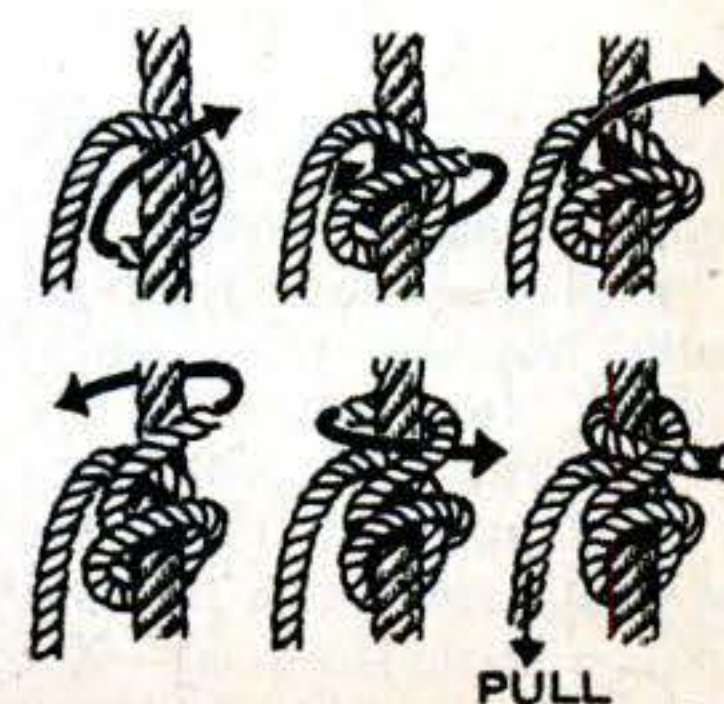
CLOVE HITCH-

MOST WIDELY USED HITCH IN FIELD RIGGING. WILL TIGHTEN AS TENSION IS APPLIED, NO MATTER WHICH END OF HITCH IS PULLED ON. USED TO FASTEN GUY LINES TO ANCHORAGES AND SPARS



THE ROLLING HITCH-

USED WHEN FASTENING ONE ROPE TO ANOTHER, ESPECIALLY A SMALL ROPE TO A LARGER ONE



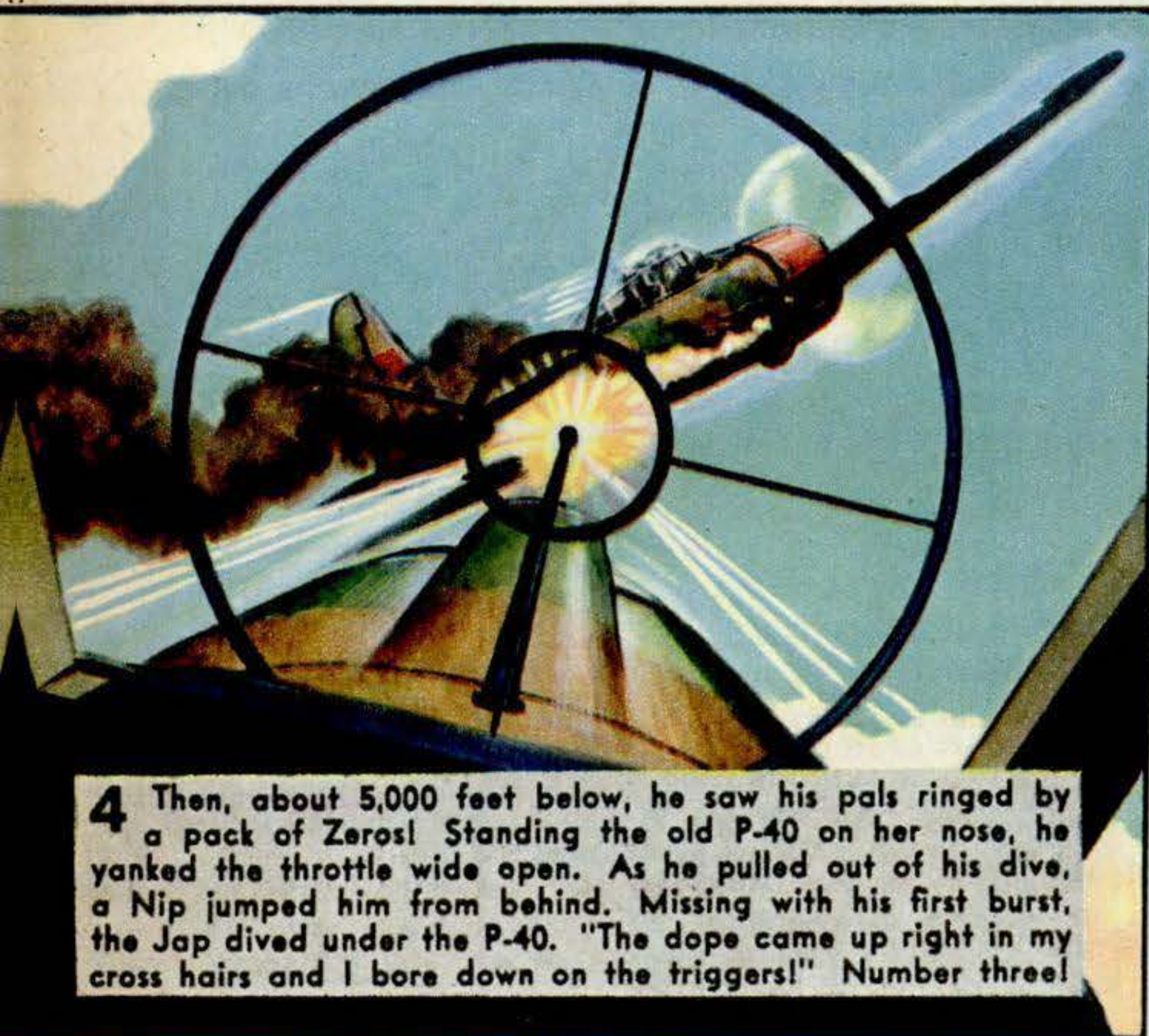
The rolling hitch is a quick, secure knot. Here the engineer uses it to fasten the small piece of rope in his hand to a large one

He Got Action!

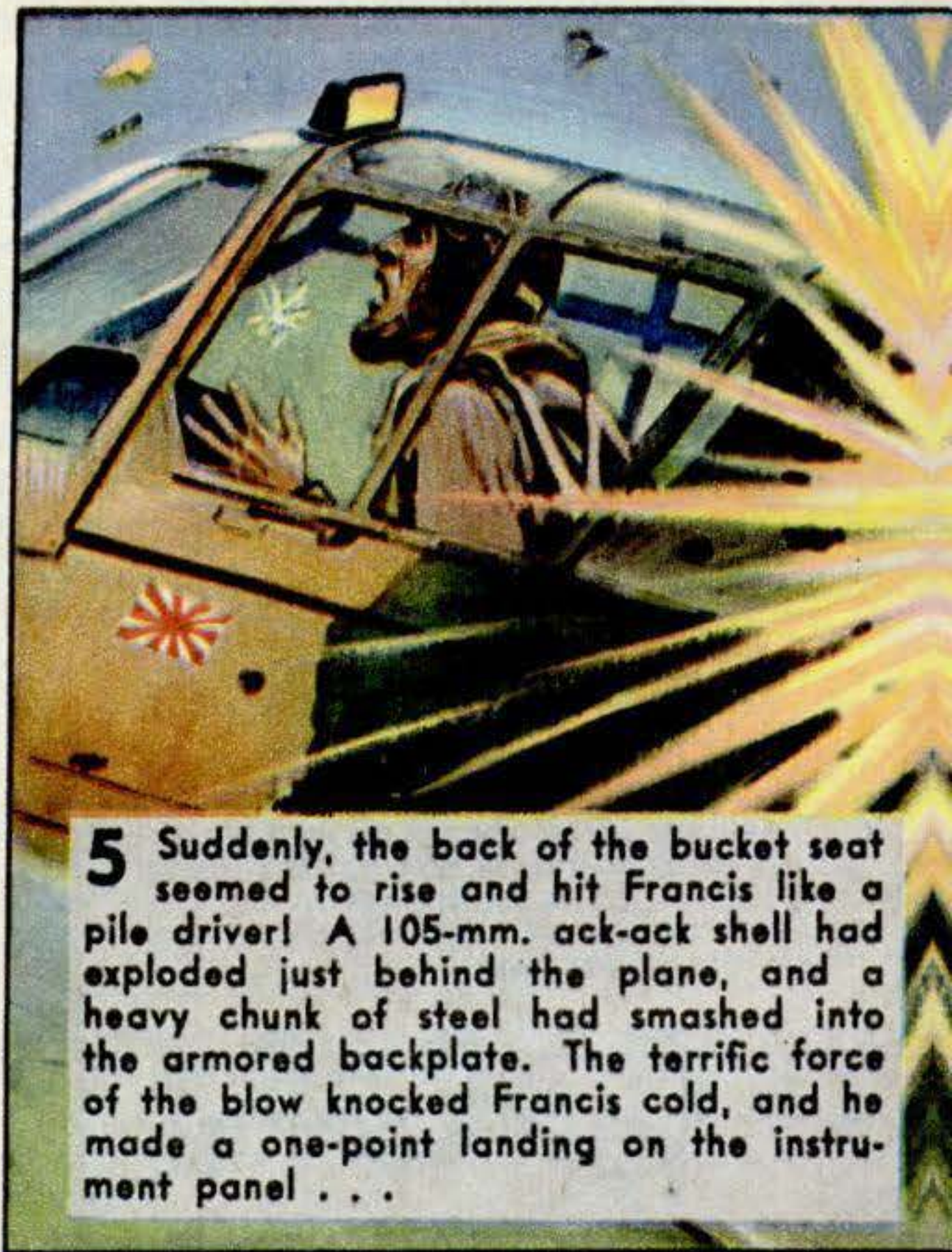
By FRANK TINSLEY

The adventures of a lifetime were crowded into four thrill-packed hours in this saga of American courage in the flaming skies of the South Pacific . . .

1 Itching for action, Lt. Mangus W. Francis took off with three other fighter pilots of the 13th Air Force on a routine combat patrol. Before the day was over, he had found plenty of excitement. Here is his story:



4 Then, about 5,000 feet below, he saw his pals ringed by a pack of Zeros! Standing the old P-40 on her nose, he yanked the throttle wide open. As he pulled out of his dive, a Jap jumped him from behind. Missing with his first burst, the Jap dived under the P-40. "The dope came up right in my cross hairs and I bore down on the triggers!" Number three!



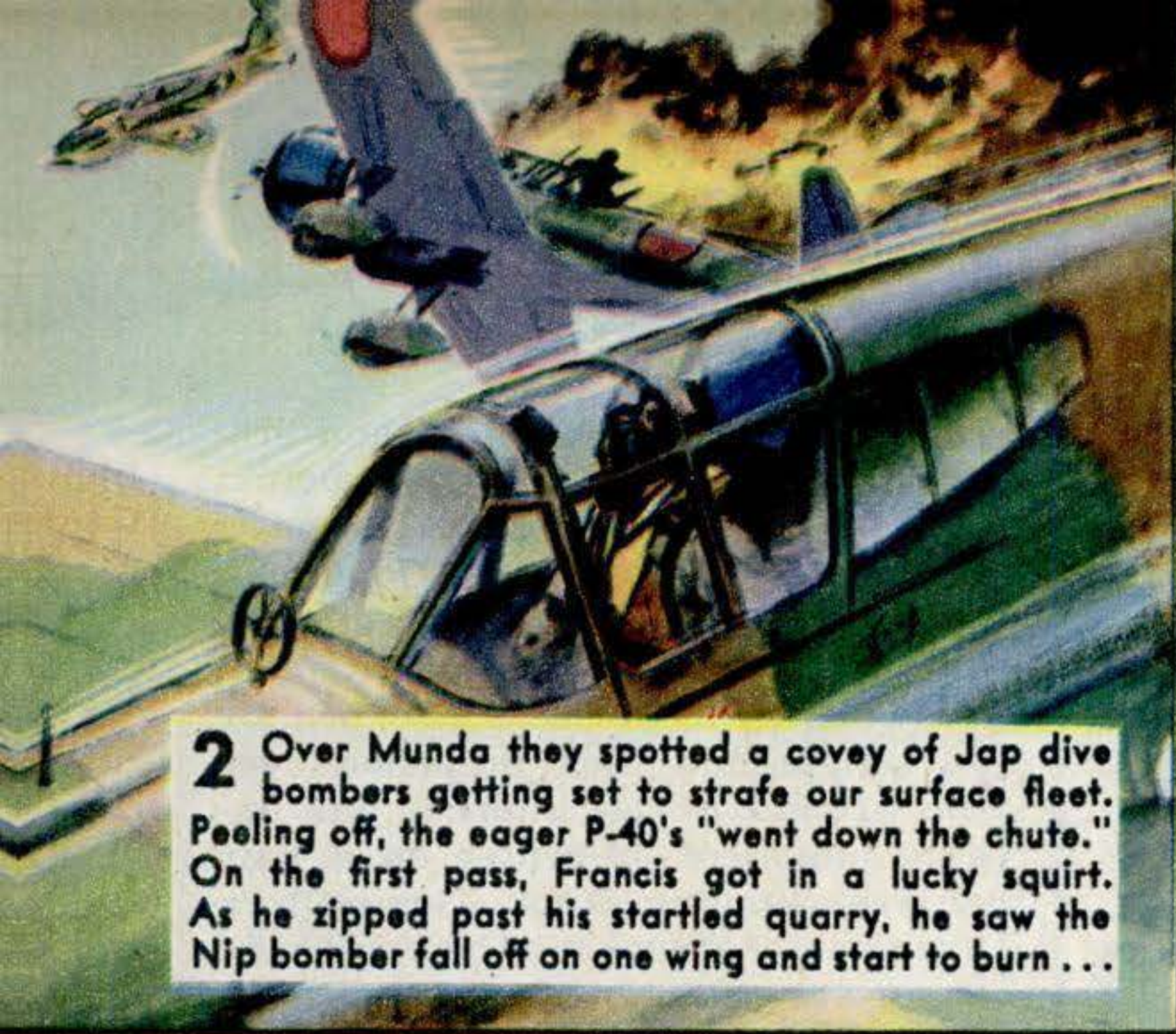
5 Suddenly, the back of the bucket seat seemed to rise and hit Francis like a pile driver! A 105-mm. ack-ack shell had exploded just behind the plane, and a heavy chunk of steel had smashed into the armored backplate. The terrific force of the blow knocked Francis cold, and he made a one-point landing on the instrument panel . . .



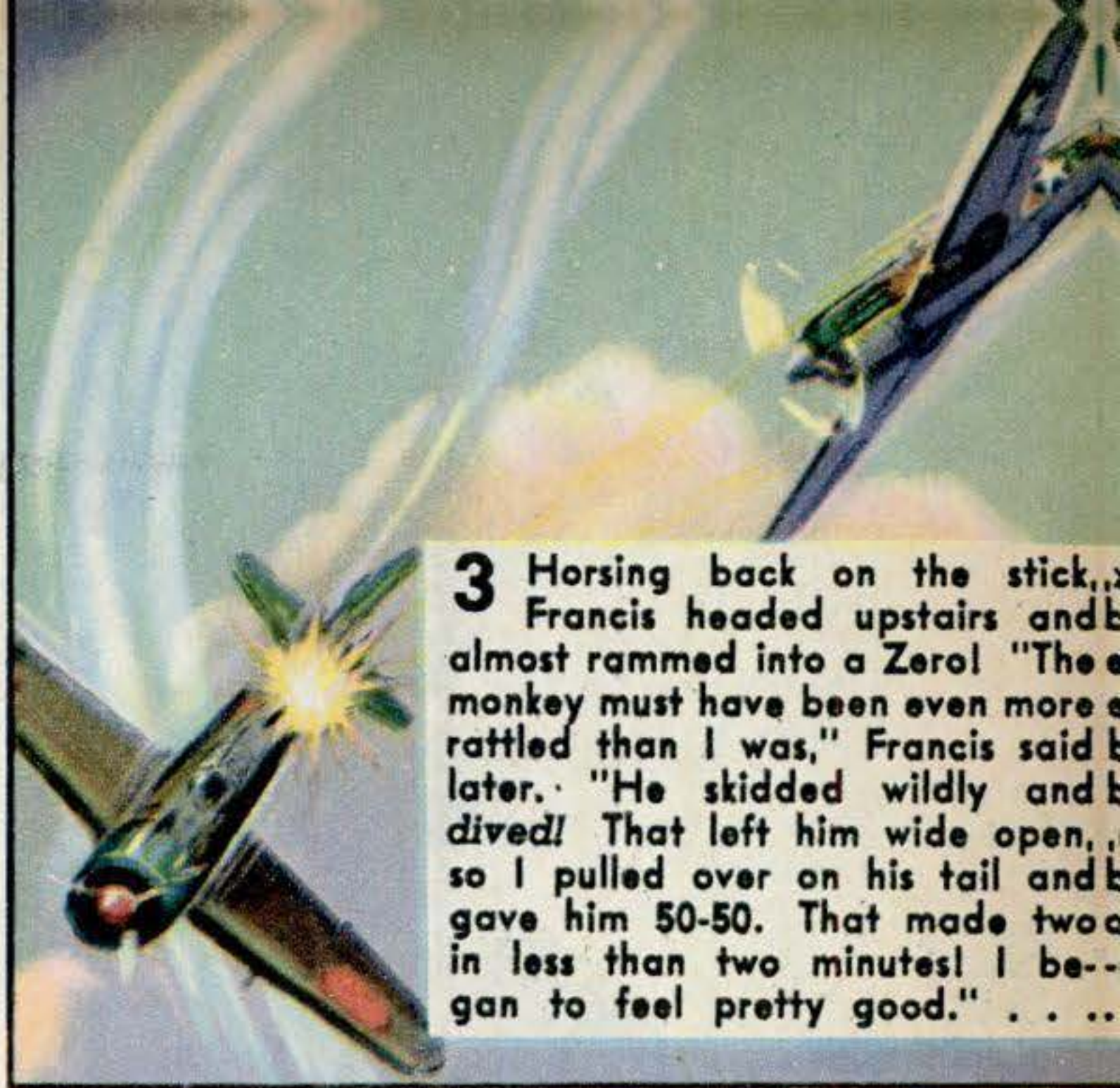
8 While the Zero wheeled for another pass, Francis murmured a prayer and loosened his 'chute harness. The water was still 100 feet away, but he figured that the drop was preferable to a burst of Jap 7.7's. Just as the Zero came around into line, a broadside of .50's from a P-40 caught its tank and blew it apart!



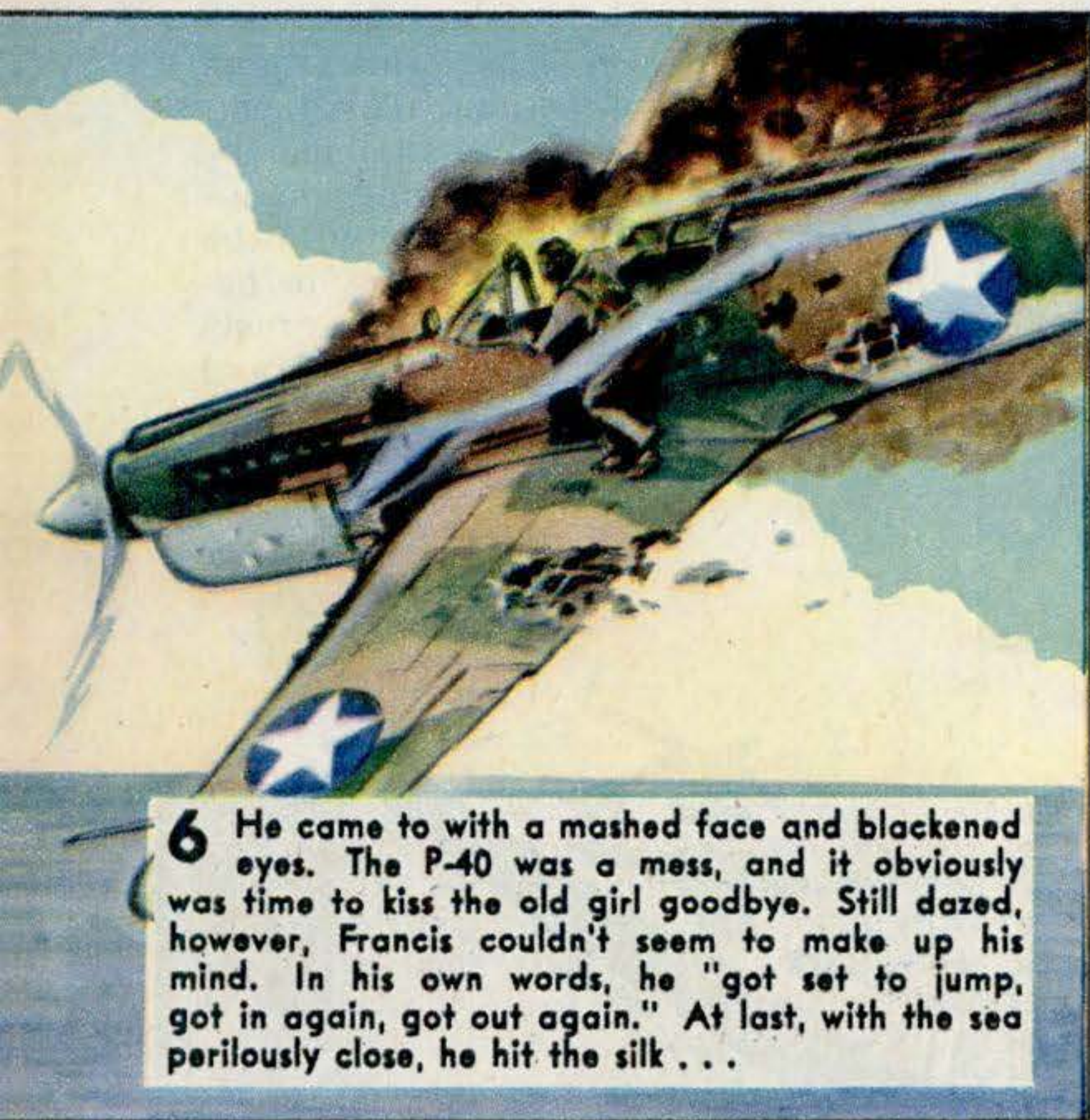
9 Slipping out of his harness as he hit the water, Francis inflated his Mae West. A moment later he was swimming for his life while vengeful Japs sprayed the telltale parachute. Pursued by Zero bullets, he dived beneath the surface, rising only for an occasional gulp of air . . .



2 Over Munda they spotted a covey of Jap dive bombers getting set to strafe our surface fleet. Peeling off, the eager P-40's "went down the chute." On the first pass, Francis got in a lucky squirt. As he zipped past his startled quarry, he saw the Nip bomber fall off on one wing and start to burn . . .



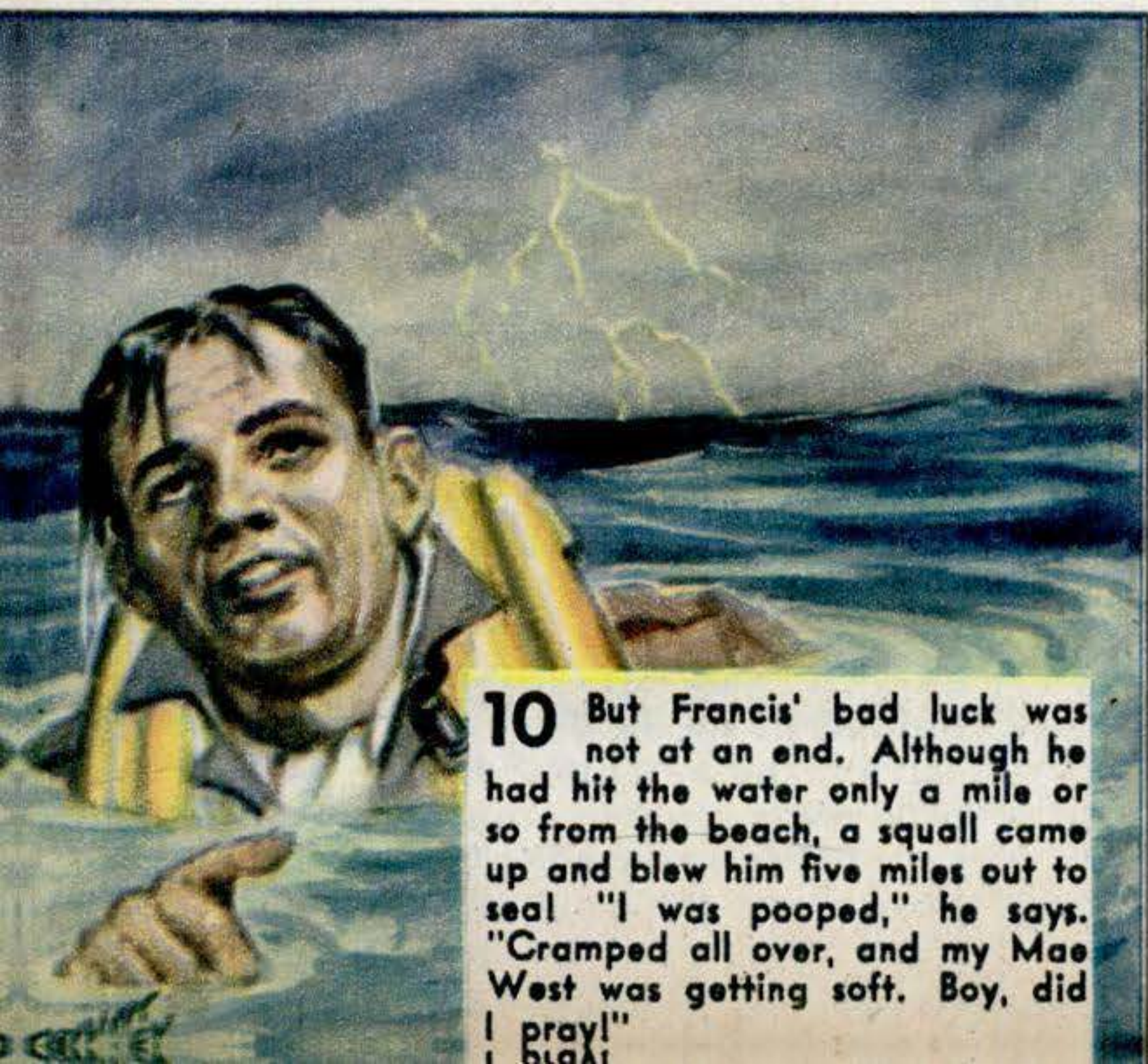
3 Horsing back on the stick, Francis headed upstairs and almost rammed into a Zero! "The monkey must have been even more rattled than I was," Francis said later. "He skidded wildly and bailed out! That left him wide open, so I pulled over on his tail and gave him 50-50. That made two in less than two minutes! I began to feel pretty good." . . .



6 He came to with a mashed face and blackened eyes. The P-40 was a mess, and it obviously was time to kiss the old girl goodbye. Still dazed, however, Francis couldn't seem to make up his mind. In his own words, he "got set to jump, got in again, got out again." At last, with the sea perilously close, he hit the silk . . .



7 As his 'chute popped, Francis heard strange snapping sounds around him, "like a kid's air gun." Suddenly a Zero whipped past and, looking up, he saw that his canopy was shredded by machine-gun bullets. The Nips were out to get him!



10 But Francis' bad luck was not at an end. Although he had hit the water only a mile or so from the beach, a squall came up and blew him five miles out to sea! "I was pooped," he says. "Cramped all over, and my Mae West was getting soft. Boy, did I pray!"



11 Four hours after he was shot down, Francis sighted a patrol plane which eventually picked him up. Now recuperating at a U. S. base, he is impatient for another crack at the Zeros. Strangely enough, he still craves action!

war ideas

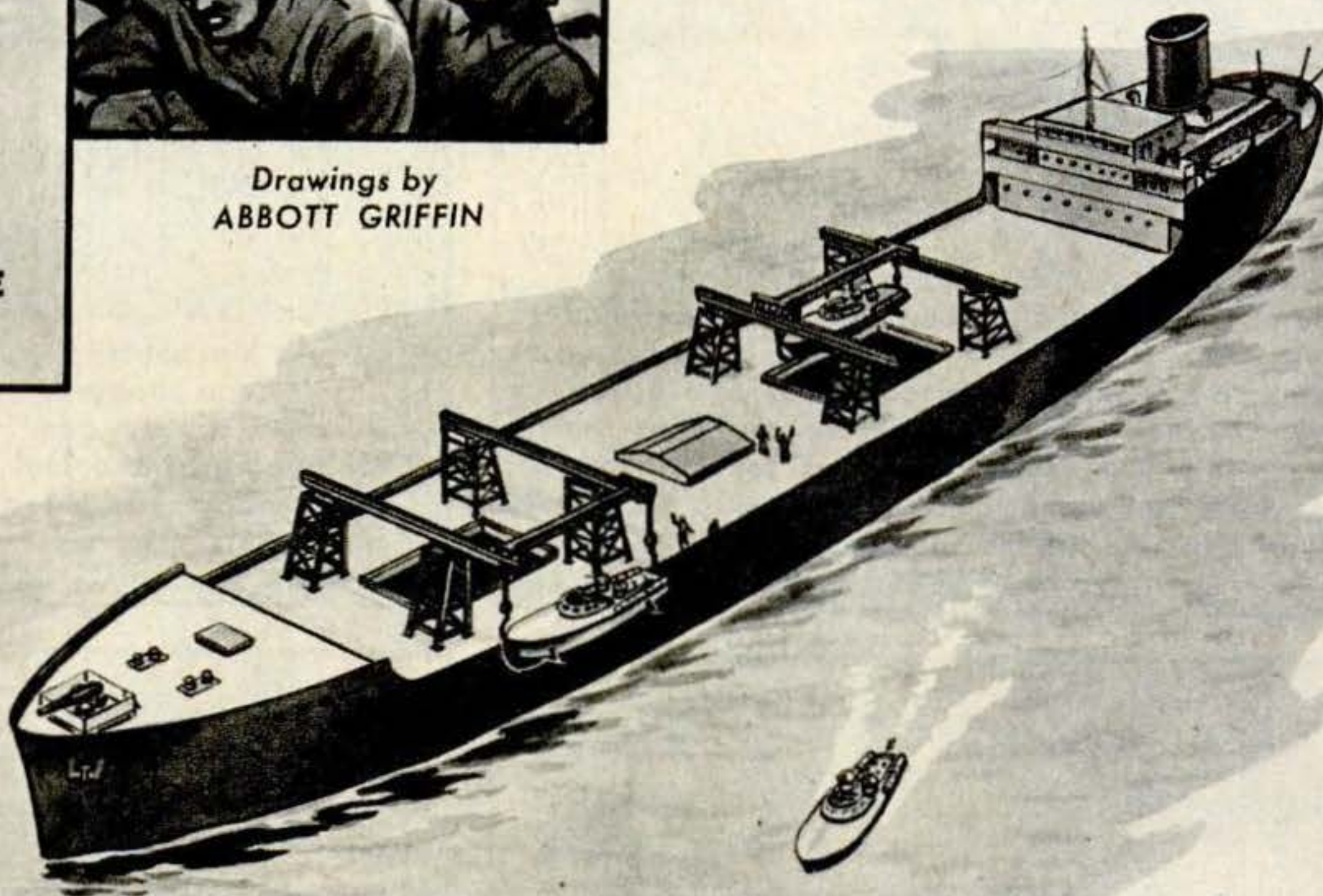
BOMBS THAT RUN WILD and create panic as well as destruction among enemy troops are the novel idea of S. L. Conrad, of Columbus, Ohio. Spherical in shape and provided with spikes with which to grip the earth, the bomb is dropped by parachute and then propelled over the ground by an internal gas engine mounted off center on a pair of free-swinging arms. Geared to a fixed center cogwheel, the engine, as it runs, constantly changes the center of gravity of the bomb and thus causes it to roll forward. Any variation in the contour of the ground will alter the direction. This, combined with a time fuse that can be changed periodically during manufacture, presents the enemy with the terrifying problem of trying to decide in which direction the fast-rolling bomb is going to move and when it is going to explode.



EXPLOSIVE

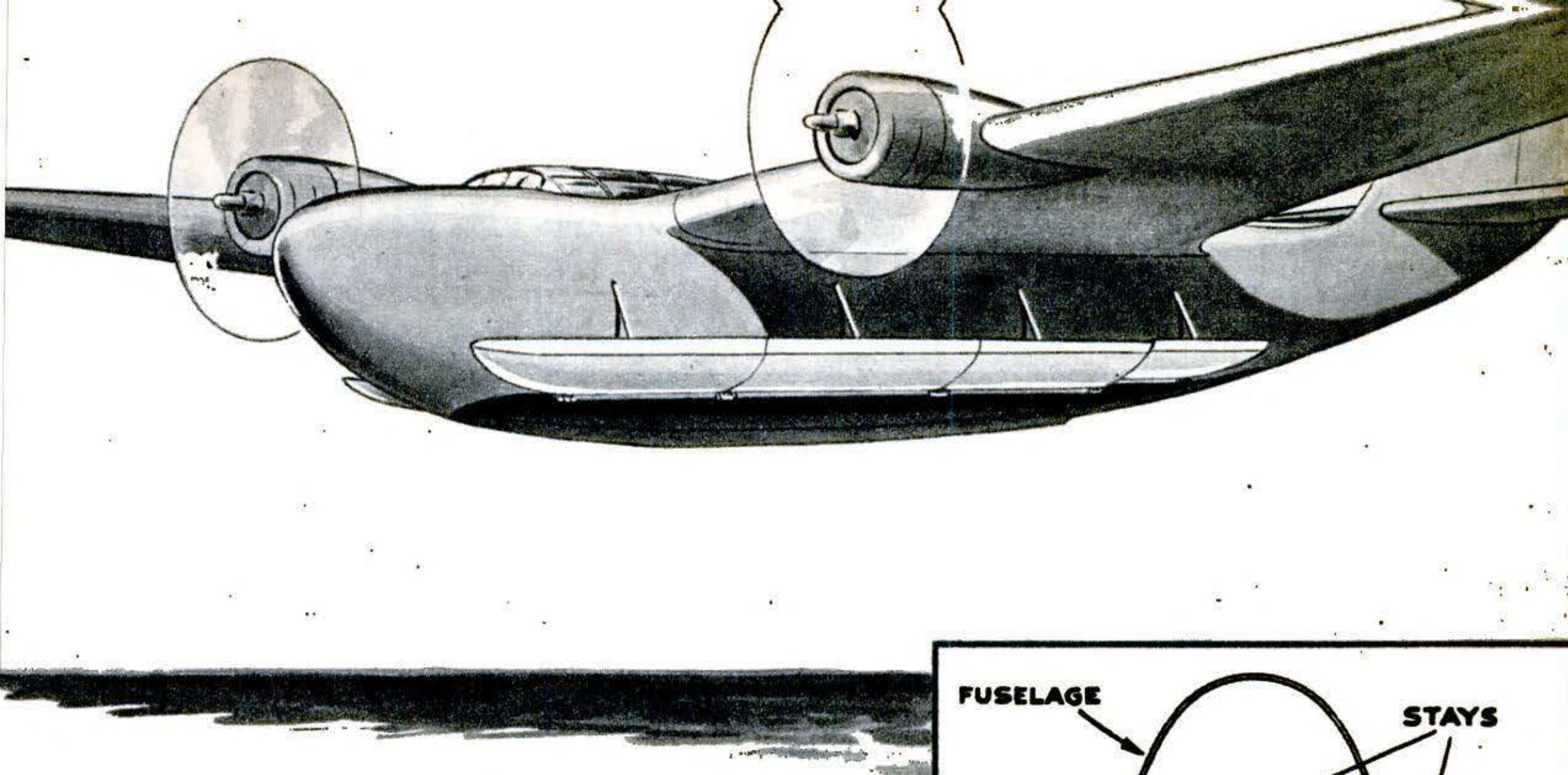
GASOLINE
ENGINE

Drawings by
ABBOTT GRIFFIN

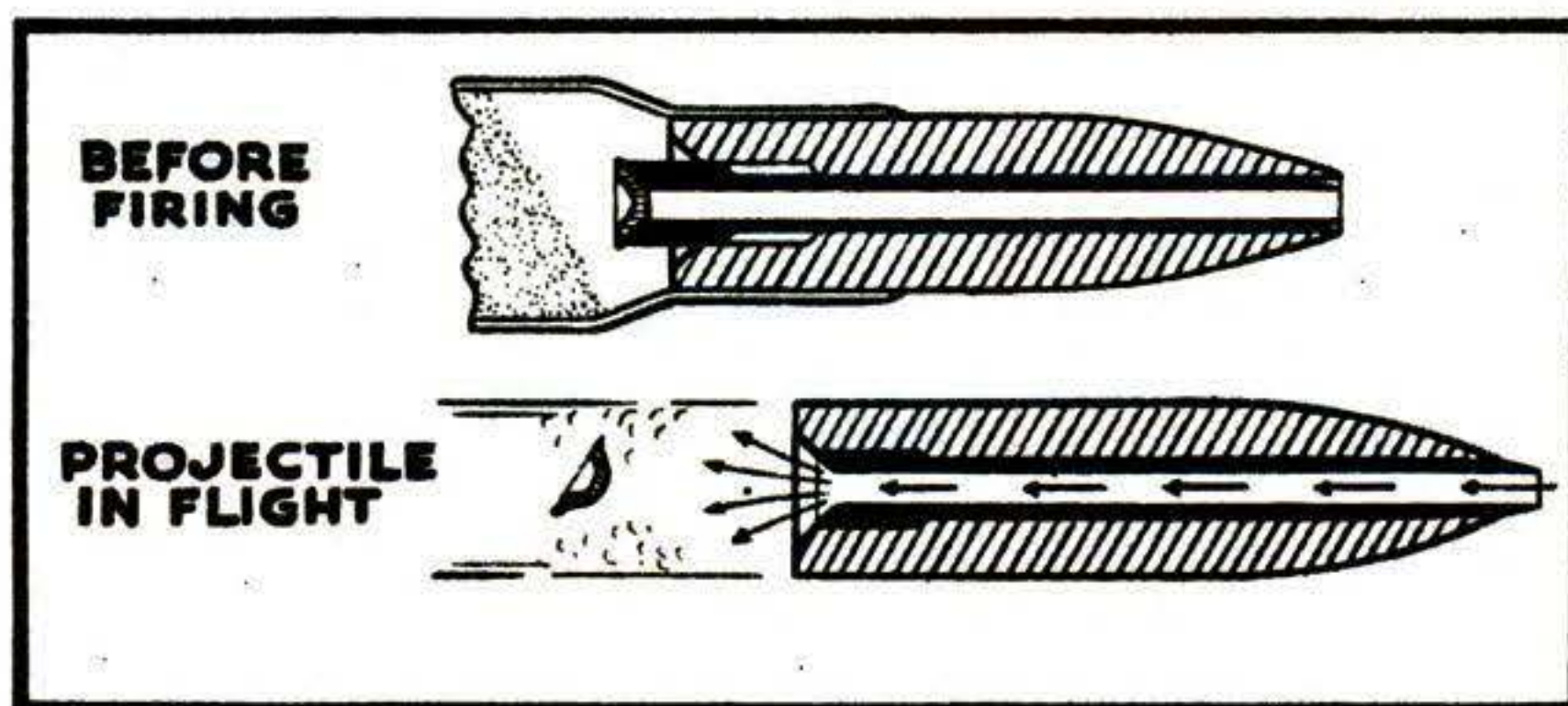
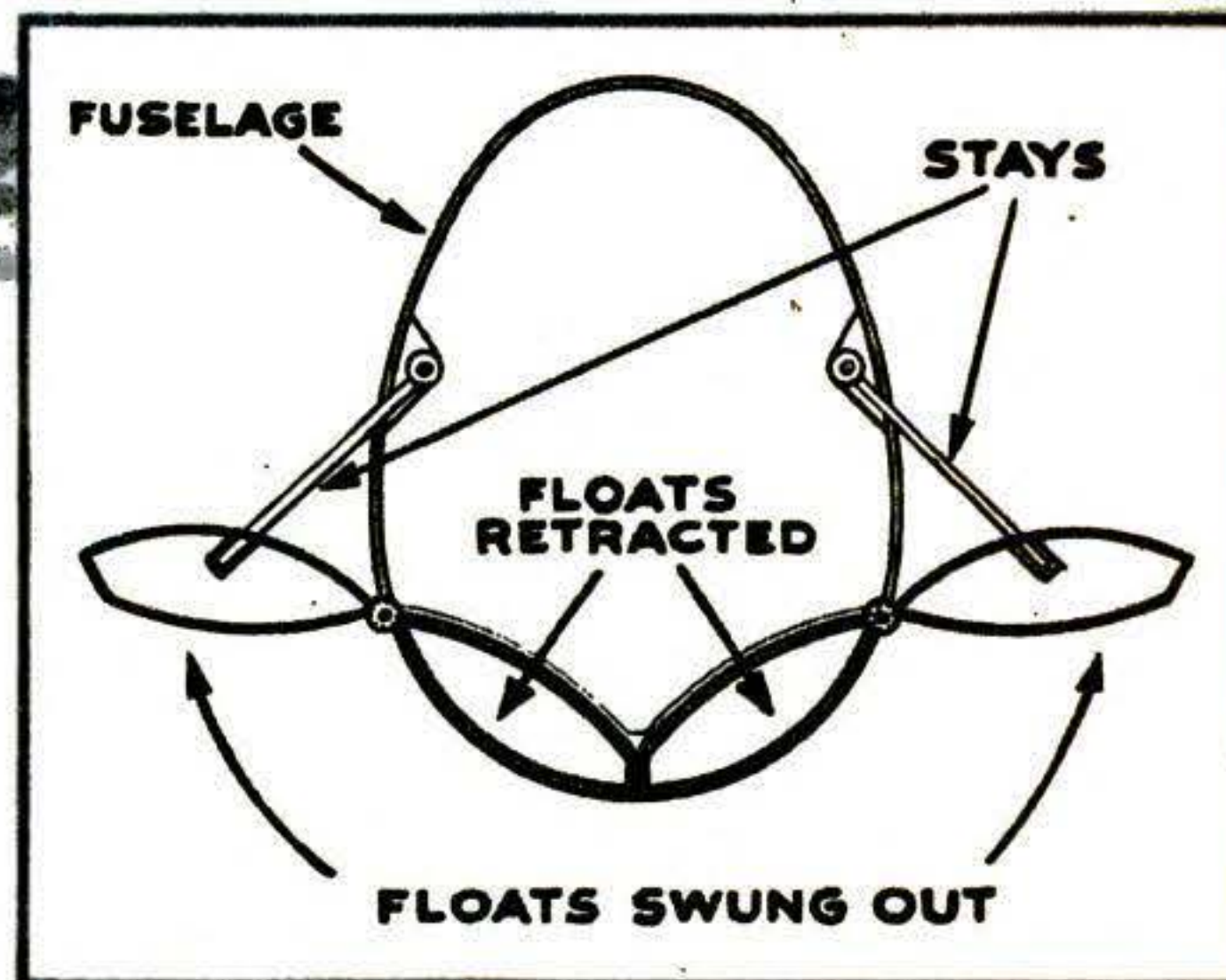


PT-BOAT CARRIERS that would operate in much the same manner as aircraft carriers have been suggested by Carl T. Forsberg, New York, N. Y. Stowed in the hold of a broad-beamed carrier, the swift and deadly little torpedo boats could be transported quickly to a battle area, where they would be lifted from the hold on central elevators, swung over the side, and lowered to the water by overhead-track cranes.

ABBOTT
GRIFFIN

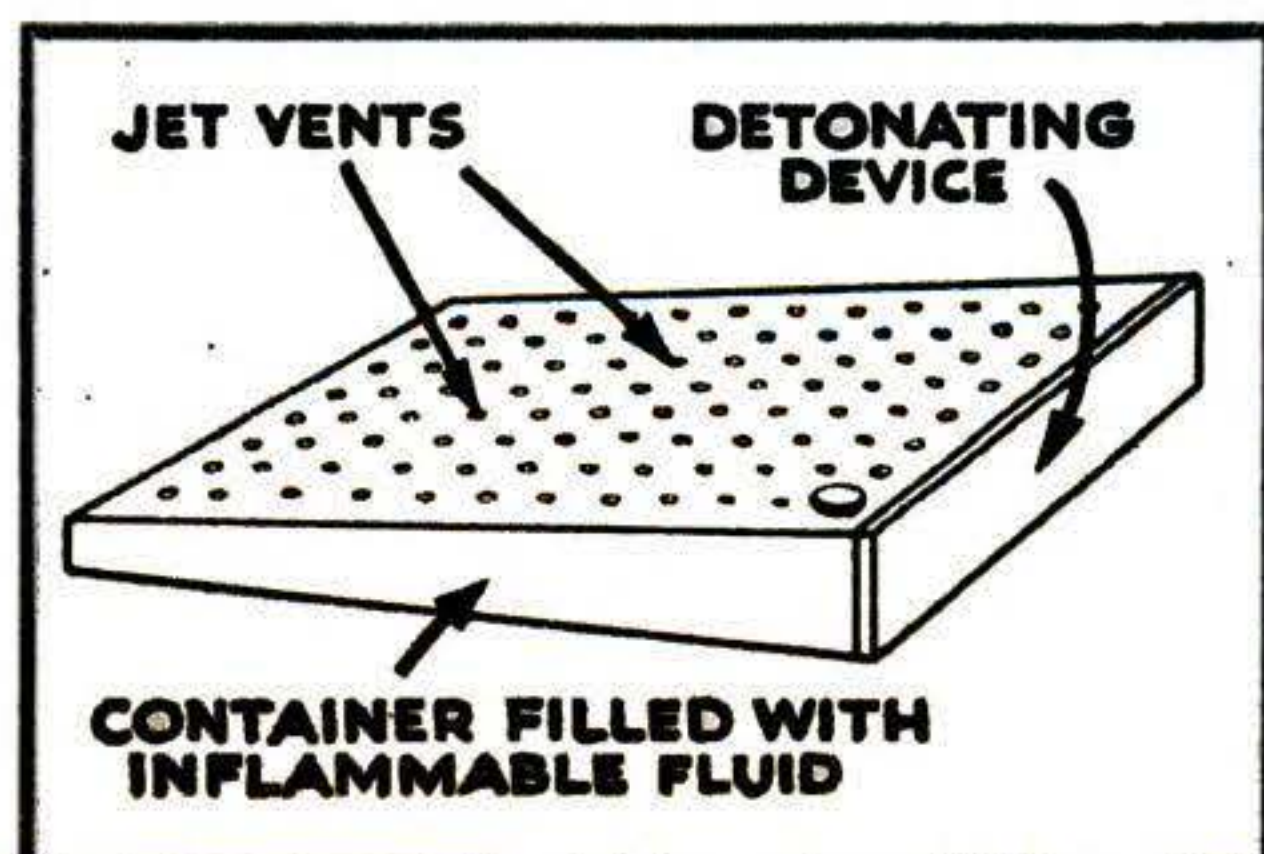


RETRACTABLE FLOATS that can be drawn up to fit snugly into the hull-like fuselage of a sea-plane have been developed by the famous German aircraft designer, Claude Dornier, to avoid the terrific drag that the pontons impose on the plane once it has taken to the air. The floats swing on longitudinal hinges. When they are drawn up, the outline of the seaplane's fuselage becomes similar to that of a conventional land plane.



HOLLOW BULLETS are advocated by G. N. Albee, Winchester, Mass., to reduce the vacuum that retards other projectiles. A plug at the rear of the nose-to-tail tube breaks off with the explosion to permit a free flow of air through the tube.

TANK TOASTER. A wedge-shaped container, filled with gasoline or other inflammable liquid and fitted with an ignition mechanism, has been designed by Dr. Gleason L. Archer, president of Suffolk University, at Boston, Mass., to give advancing enemy tanks a warm reception. As a tank rolls over the container, it causes the gasoline to squirt upward through the container's jets, and at the same time sets off the mechanism that will ignite the fuel.



Can You Recognize The Flags of Our Allies?

UNITED in common purpose, freedom-loving nations on six continents now carry the fight to the enemy. Theirs is the most powerful union the earth has ever seen. Evidence of that strength flexes before us like a giant muscle. For added to America's own fabulous resources and manpower are those of big and little allies whose total populations approach a billion and a half and whose boundaries enfold 25,000,000 square miles of free lands—six times the size and population of territory in Axis hands. These nations are pledged to end international lawlessness, greed, and oppression. Their flags fly beside Old Glory. On these pages are the flags of the

United Nations, as of October 11, 1943. Each symbolizes our hopes for a better world. They are flags we should know at a glance. Unfortunately, not many of us do. When, for instance, Secretary of State Cordell Hull welcomed Iran into the ranks of the United Nations, few persons were familiar with the flag that became the thirty-third in that distinguished company. Few know that 18 of the Allied banners have red, white, and blue combinations, or that words are printed on five.

Study these flags of our friends and neighbors. When you think yourself familiar with all of them, turn to page 204 and test your knowledge.



AUSTRALIA



BELGIUM



BRAZIL



BOLIVIA



CANADA



CHINA



COSTA RICA



CUBA



CZECHOSLOVAKIA



DOMINICAN REPUBLIC



EL SALVADOR



ETHIOPIA

UNITED STATES



POLAND



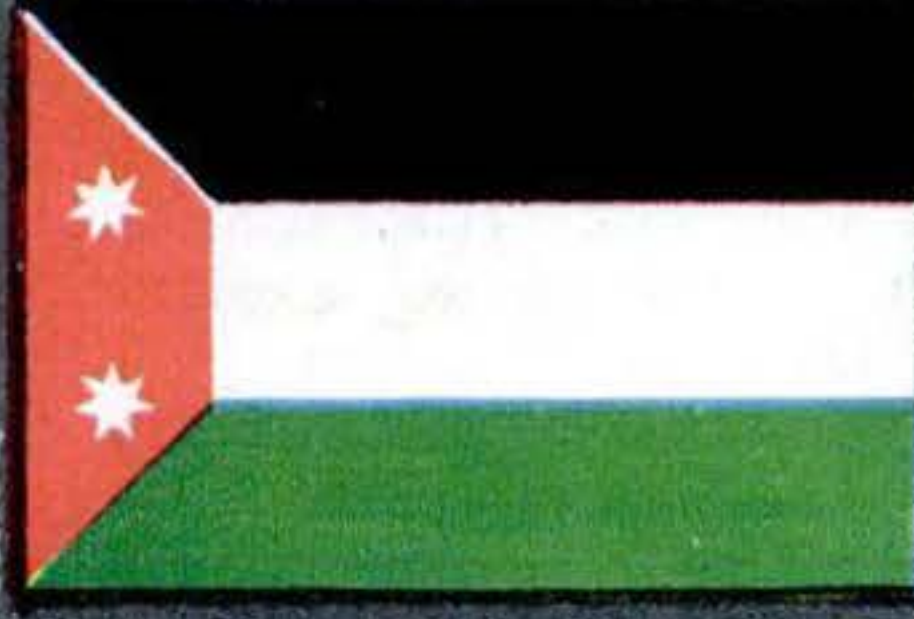
NORWAY



NETHERLANDS



IRAQ



HONDURAS



GREECE



U.S.S.R.



SOUTH AFRICA



PANAMA



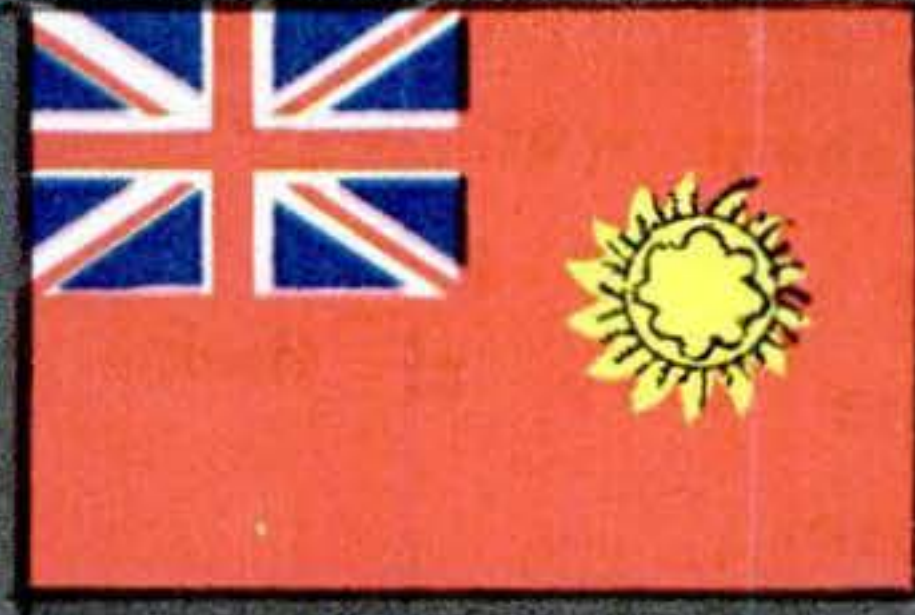
NEW ZEALAND



LUXEMBOURG



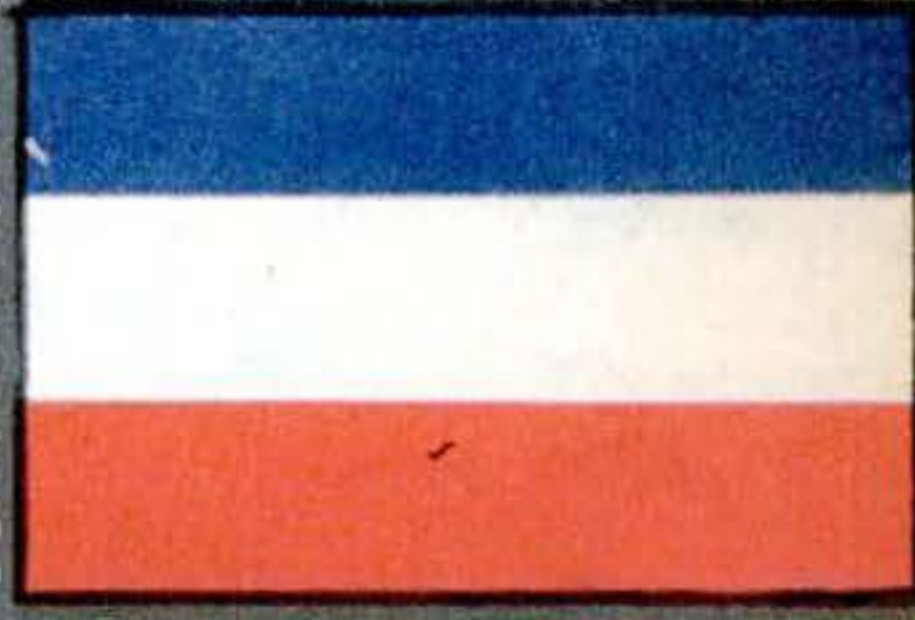
INDIA



GUATEMALA



YUGOSLAVIA



UNITED KINGDOM



PHILIPPINES



NICARAGUA



MEXICO



IRAN



HAITI



Silent Partner of the Plane

A new weapon of the present war, motorless aircraft have won a secure place in battle tactics. Here's the story of their development and current use.

By **ALDEN P. ARMAGNAC**

Photographs by **ROBERT F. SMITH**

TRIED out for the first time in this war, are military gliders a success? What do they look like, and how do they work? And what are the postwar prospects of gliders in commercial aviation?

When Germany staged the first mass use of gliders, to invade Crete, and U.S. and British gliders returned the compliment in taking Sicily, their worth for certain specialized missions was definitely proved.

For leading an aerial blitz, glider troops have an advantage over paratroopers: they all land together, saving priceless moments in collecting weapons, getting organized, and going into action. Quickly and inexpensively replaced, compared with powered troop transports, gliders are expendable. Even if pieces of wings and tail go flying, it means nothing to slam a troop-carrying glider into a high-speed crash landing on rough ground; a strong cage of structural tubing protects the crew. Unlike cargo parachutes that the winds may carry astray,

manned cargo gliders deliver supplies to ground troops just where they are needed.

Military gliders differ most conspicuously from prewar sporting sailplanes in being towed, like flying trailers, all the way to their destination. In former practice, pilots took advantage of rising warm-air currents called "thermals" to stay aloft, and civil aviation authorities barred airplane tows as too dangerous. How far gliding has advanced since then was demonstrated

last summer by the first transatlantic glider flight, made in tow of an airplane from Montreal to London.

Landing gear for a typical military glider, which gives it a characteristic squat appearance on the ground, consists of ski-like steel runners and a pair of rudimentary wheels. In some models, the wheels may be dropped after taking off; they parachute to earth for recovery and re-use.

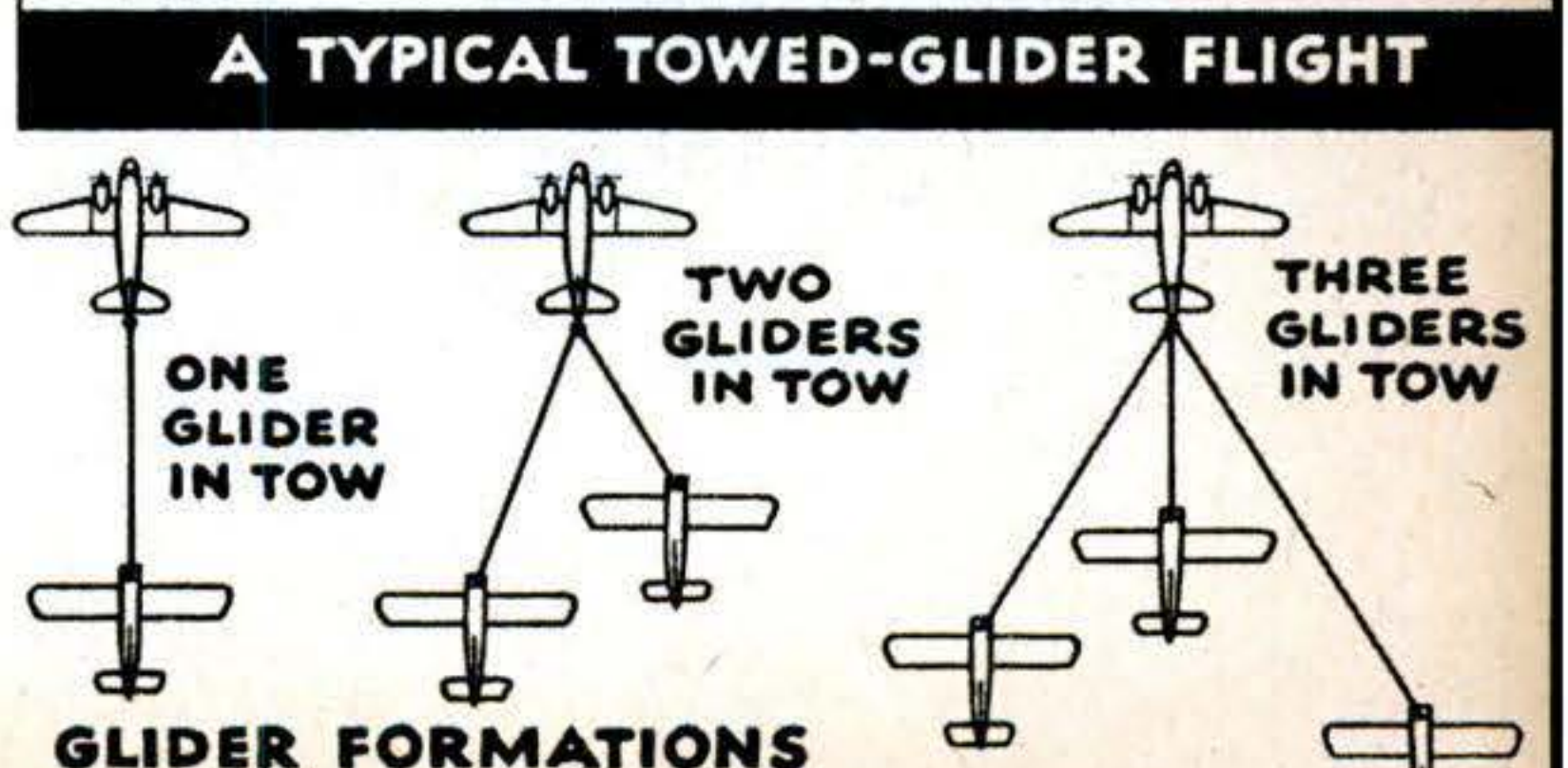
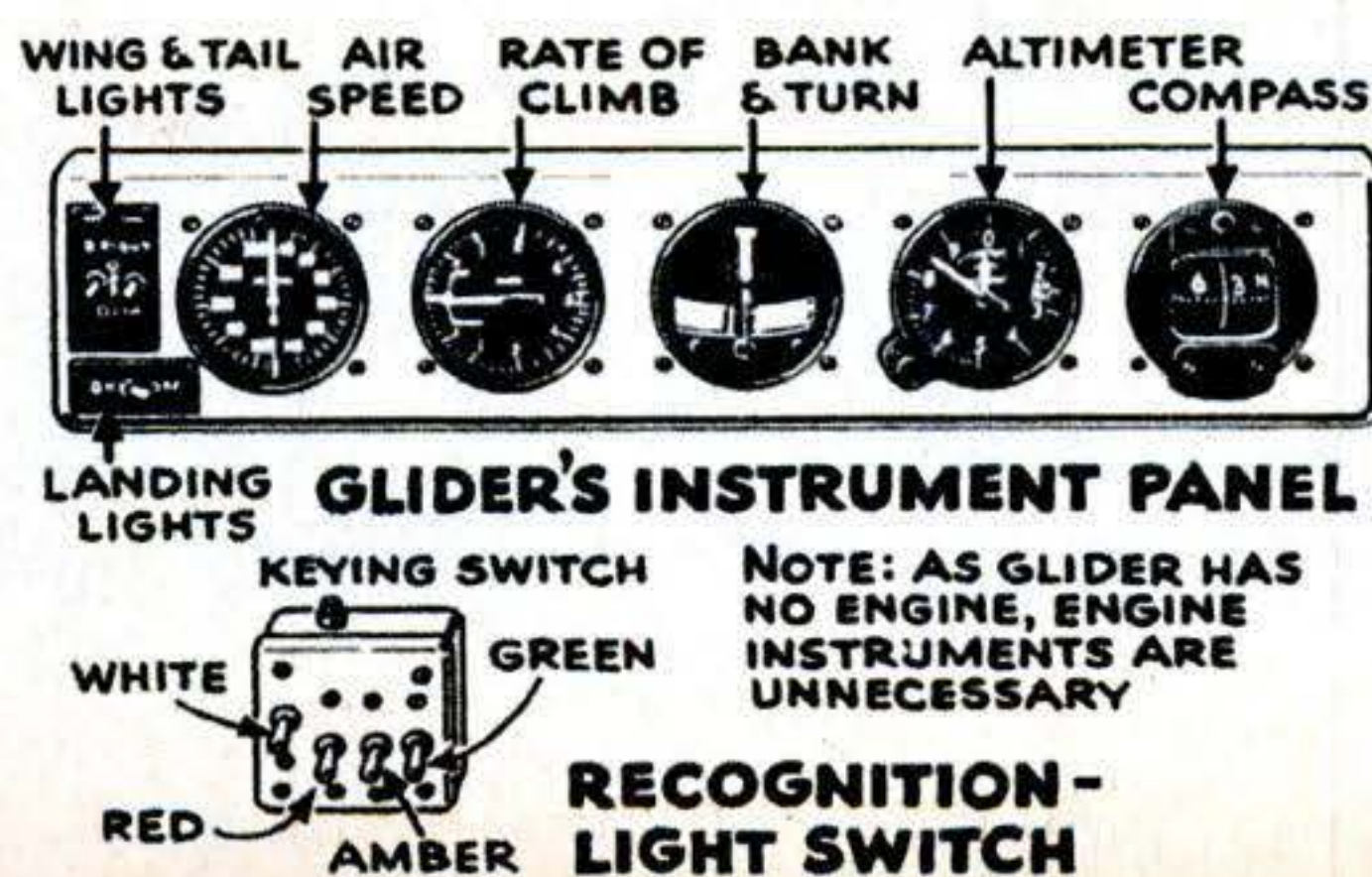
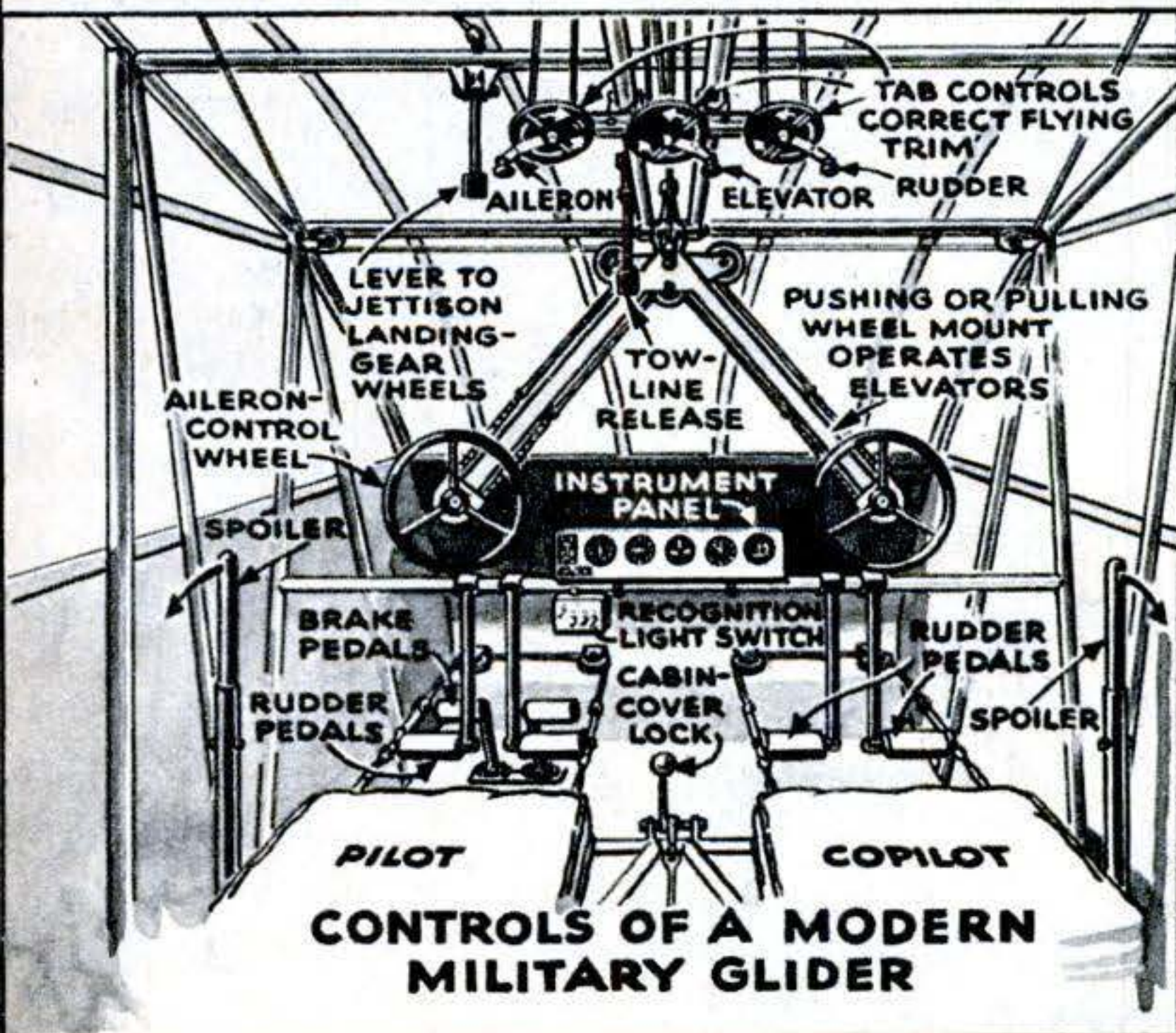
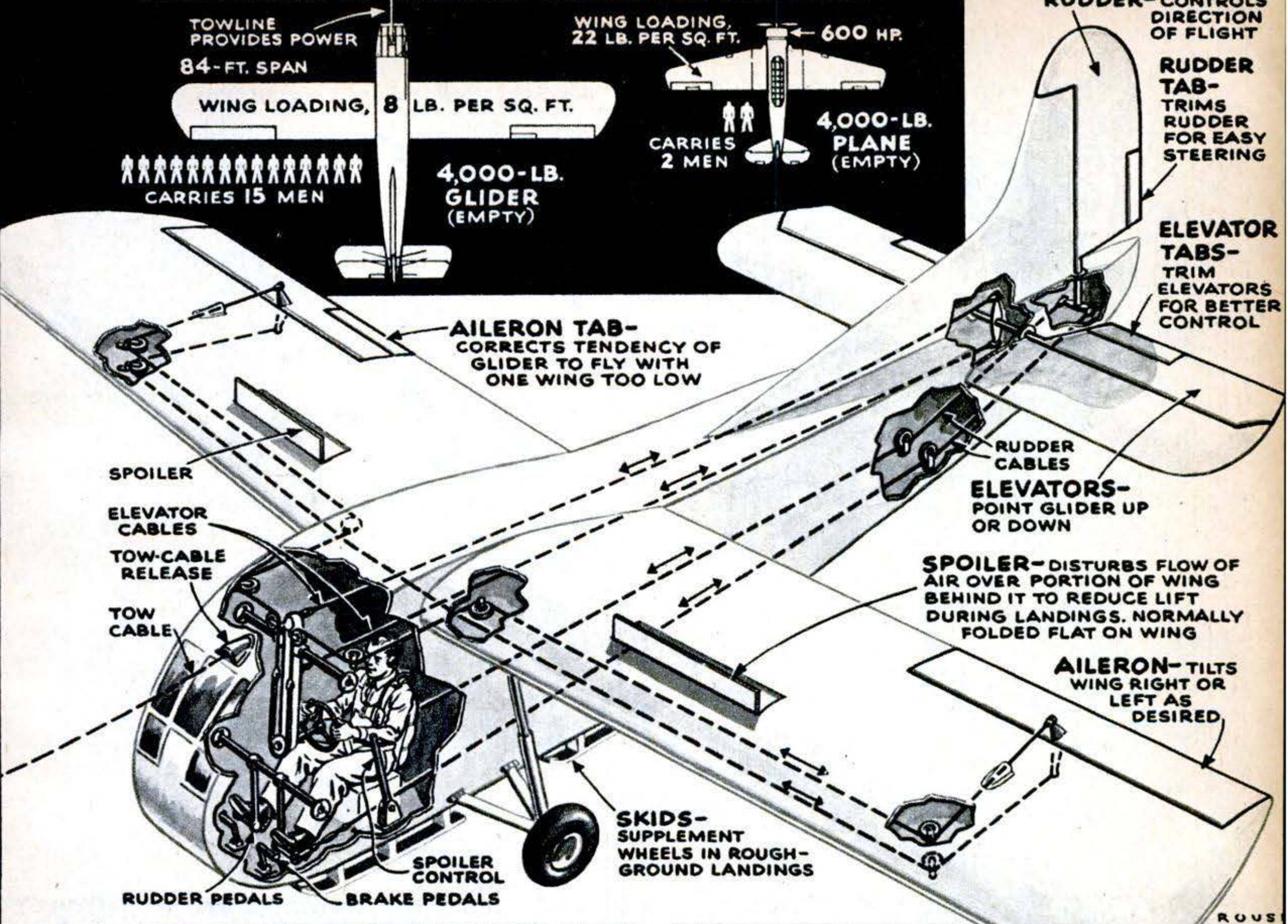
For a normal take-off, both the tow plane and the glider start down a runway together, connected by a shock-absorbing cable of nylon—so elastic that it will stretch by a third and then slowly contract to its original length. When more than one glider is attached, towlines vary in length to keep wing tips from colliding. Fanlike formations alone are used, since gliders strung one behind another would be unmaneuverable.

In flight, tow-plane and glider pilots converse by two-way radio. At the destination, the glider pilot pushes an overhead lever that unleashes his craft. Instead of buffeting the wind, he now rides with it, and its gentle murmur permits (*Continued on page 98*)

A U. S. Army student glider pilot receives last-minute instructions before taking off in a TG-8, one of a number of Army training models. This three-place motorless craft glitters in brilliant silvery paint



COMPARISON OF MILITARY GLIDER AND AIRPLANE



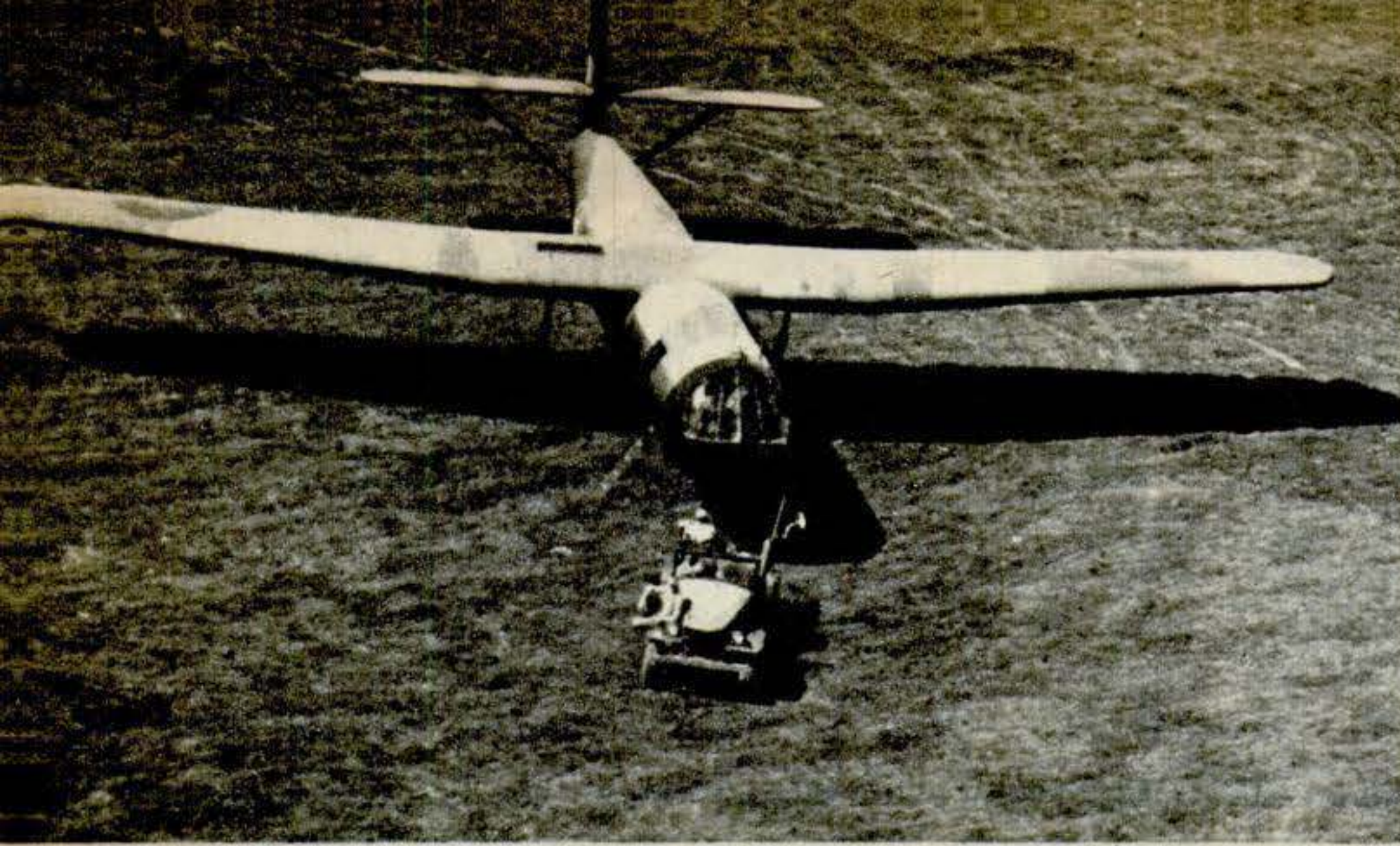


TRAINING. U.S. Army glider pilots master motorless flying in sleek training craft such as the two-place TG-4 seen above. With their long, narrow wings, our trainers are reminiscent of peacetime sailplanes. These Kodachrome shots were made by Robert F. Smith near the Wilmington, Ohio, glider field

With its towline attached and the pilot in his tiny cockpit, the TG-4 below is poised for the take-off. Unlike sporting sailplanes, which depended on rising air currents to stay aloft, military gliders are towed to a point near their objective, then released. The elastic towline absorbs much of the shock at the start





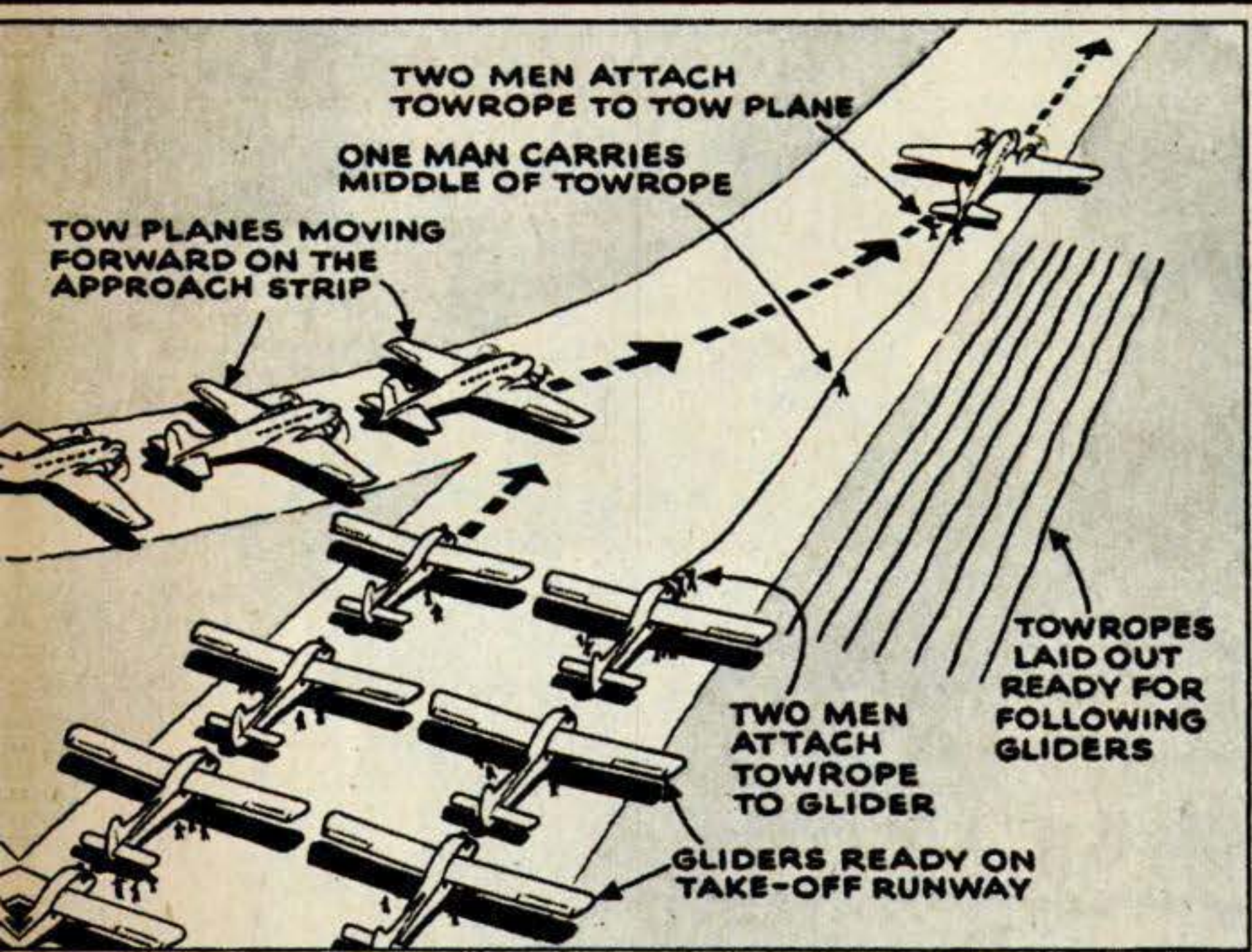


Towed by a tractor, a British Horsa goes back to its hangar after a flight. Wings and fuselage are mottled above, painted jet black below

occupants to talk without raising their voices.

To lose altitude rapidly, the pilot raises a pair of solid flaps called "spoilers," which kill the lift of the wings. A spectacular innovation, illustrated on this month's cover, has recently been tested for checking a glider's forward speed. It consists of a horizontal parachute, unfurled from the glider's tail in midair, and released or retained as the craft strikes ground. With such quick-landing aids, a

SOME OF THE JOBS THAT GLIDERS ARE BEST FITTED TO DO

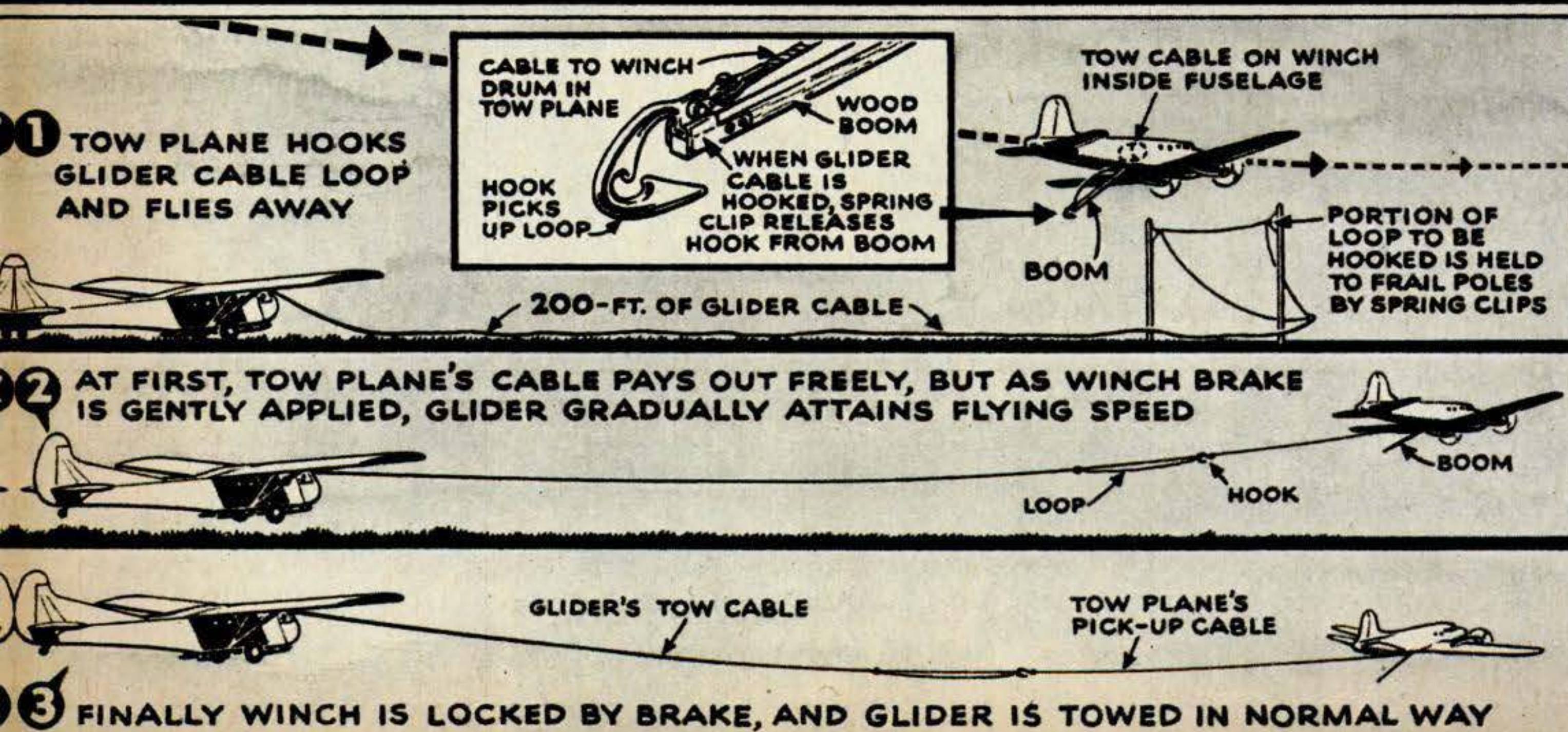


High-speed launching puts fleet quickly in air



Troops land in enemy's rear . . .

Pickup recovers gliders from fields where tow planes cannot land



tree-skimming approach exploits the element of surprise to the fullest.

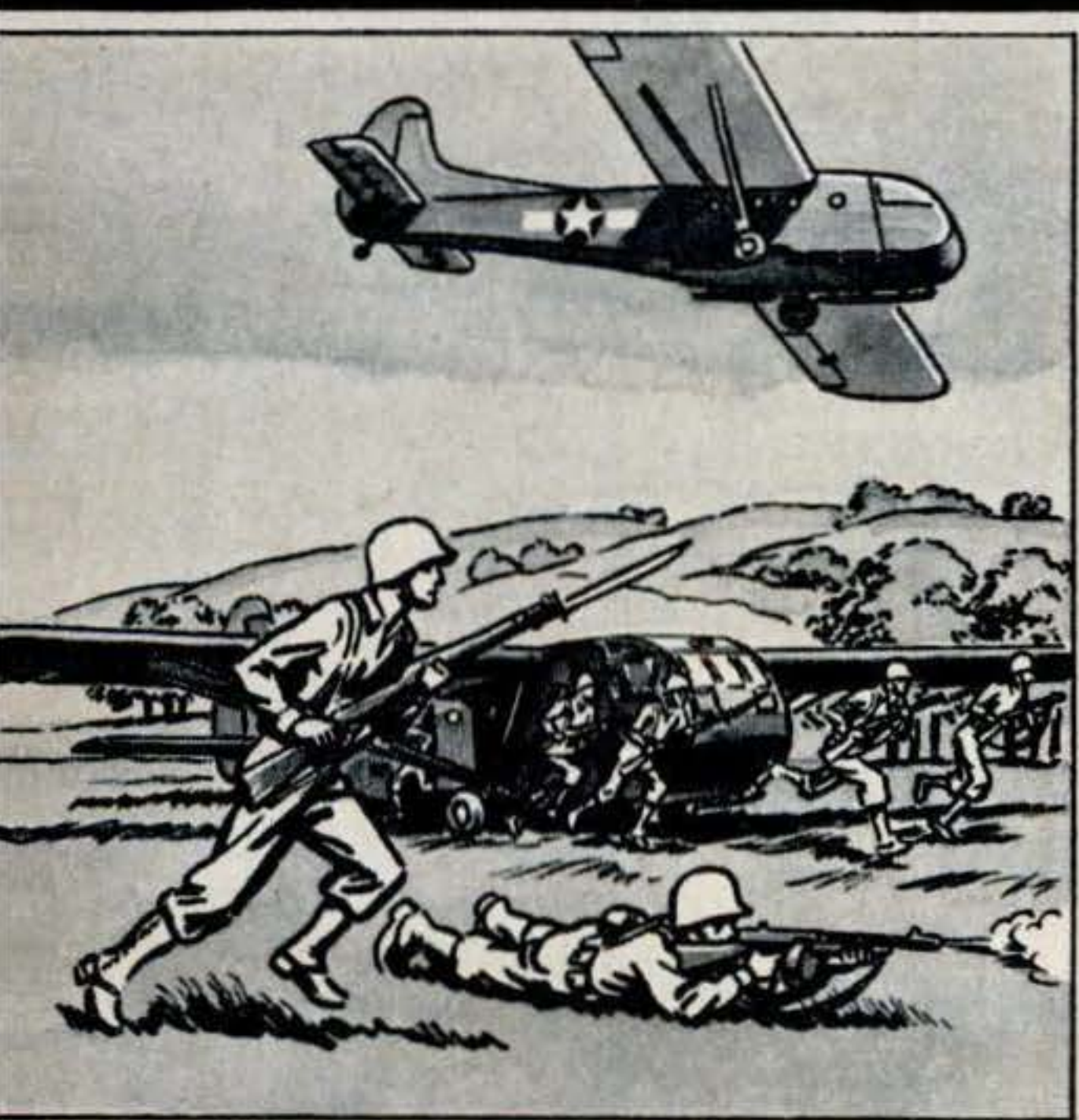
Gliders of the U. S. Army Air Forces now range in size from tiny, colorful training craft, called TG's, up to the big green CG-4A, which doubles as a carrier for troops and for cargo. Pending development of still larger and more formidable gliders, the CG-4A—currently in mass production—is the Army's standard type. As a troop carrier, it holds 15 men, including pilot and copilot. Alternatively, it transports a jeep and six men. Other cargoes may consist of 37-mm. antitank guns, 75-mm. pack howitzers, motorcycles, food, and ammunition. Overall, a CG-4A measures about 84 feet in wing span, and 48 feet in length. In addition to doors

at its sides, its whole nose may be opened to discharge men and equipment.

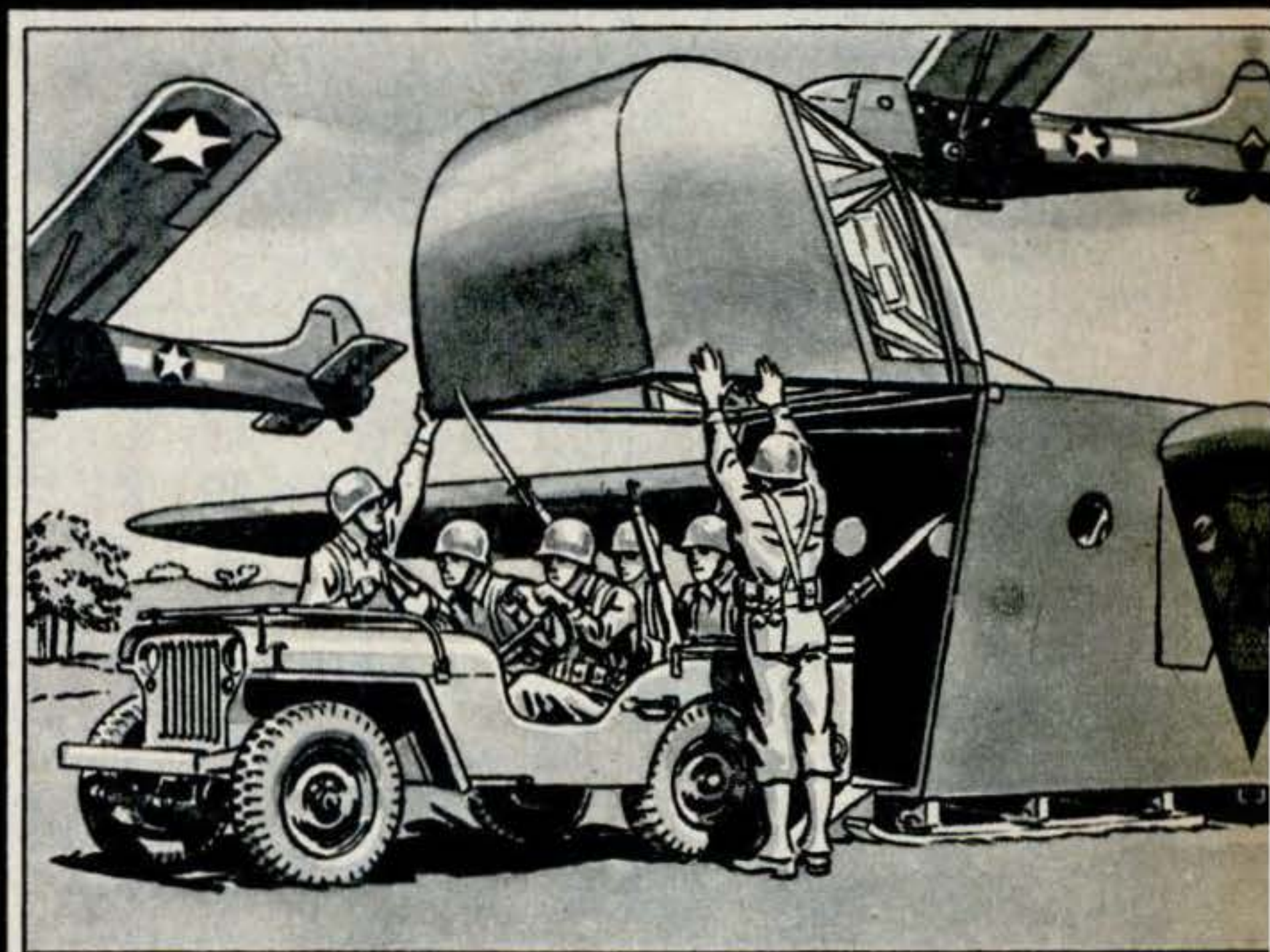
Military experience has demonstrated limitations as well as advantages of gliders. You can't get something for nothing by hitching a glider behind a plane. It takes power to pull it. Trials seem to confirm the conservative opinion that, for long hauls, a powered plane alone will transport a load more efficiently.

Nevertheless, gliders appear destined to play an important role in commercial aviation, closely paralleling their special military advantages. Feeder lines, connecting out-of-the-way communities with through airways, can employ multiple glider tows to pick up and let off passengers at any point along the way. (CONTINUED)

... AND HOW THEY ARE HANDLED IN MILITARY OPERATIONS

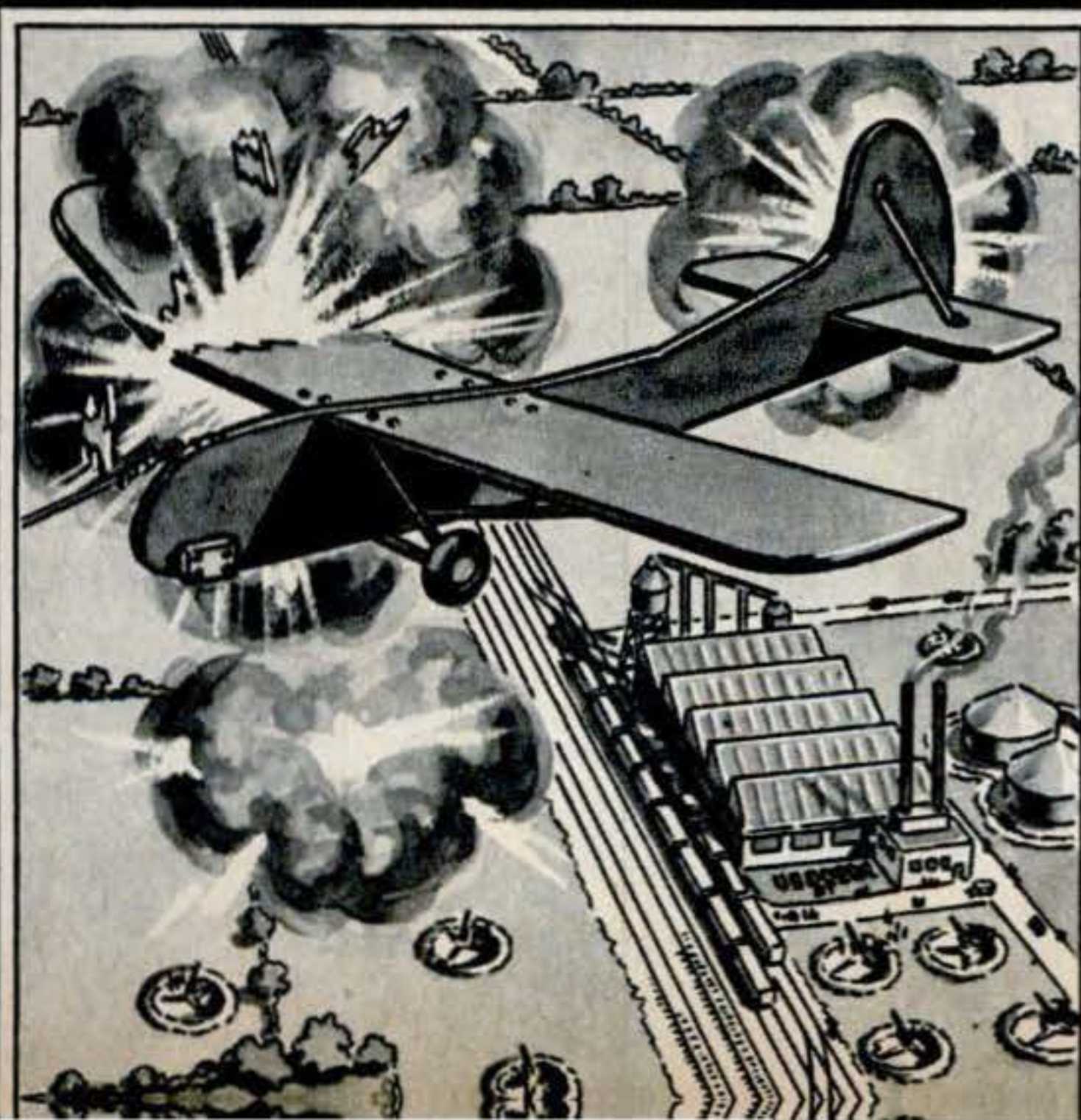


... together, ready to fight



Jeeps, guns, and supplies carried to the front

Glider models are targets for gunners



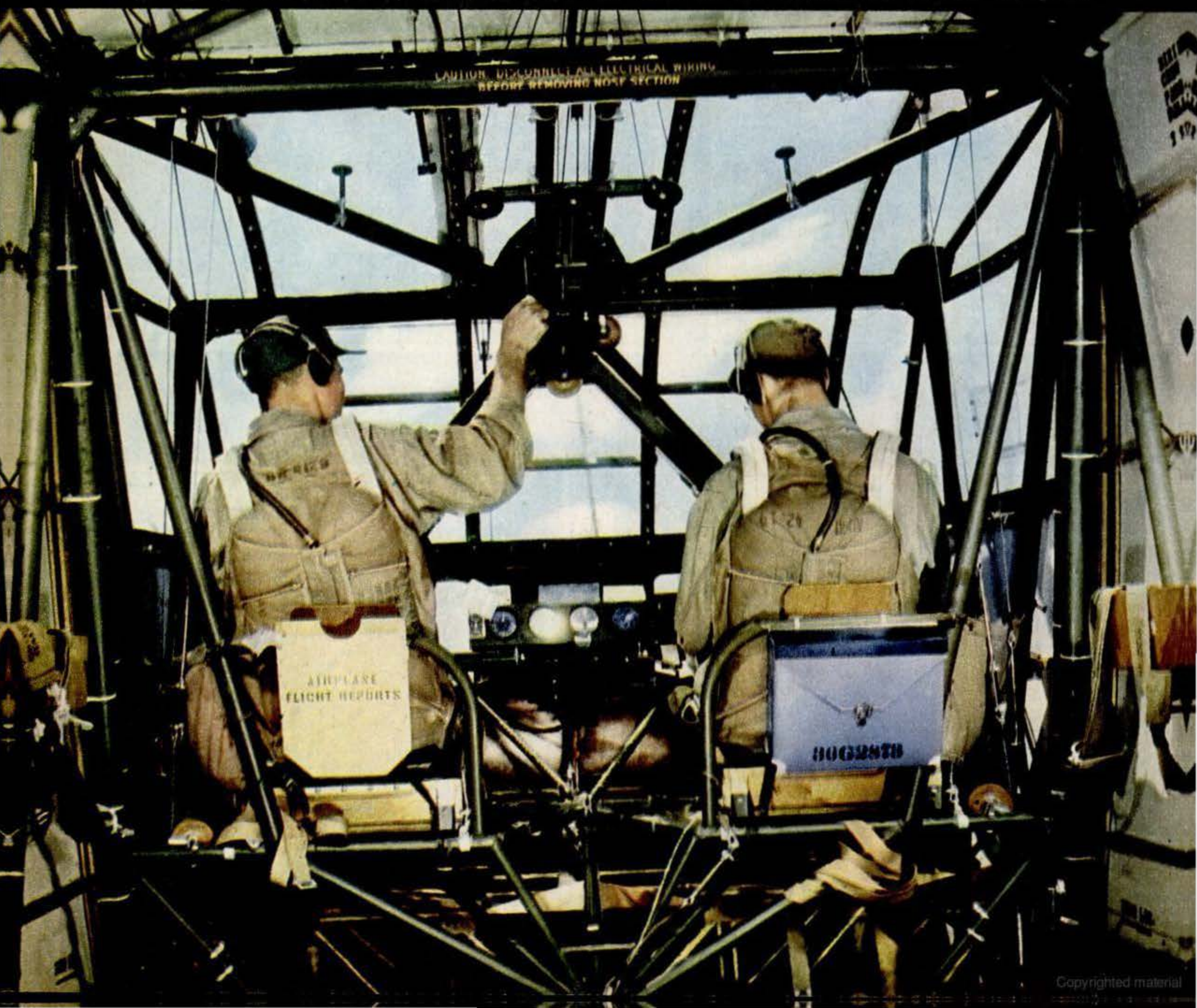
Wheels may be dropped by parachutes

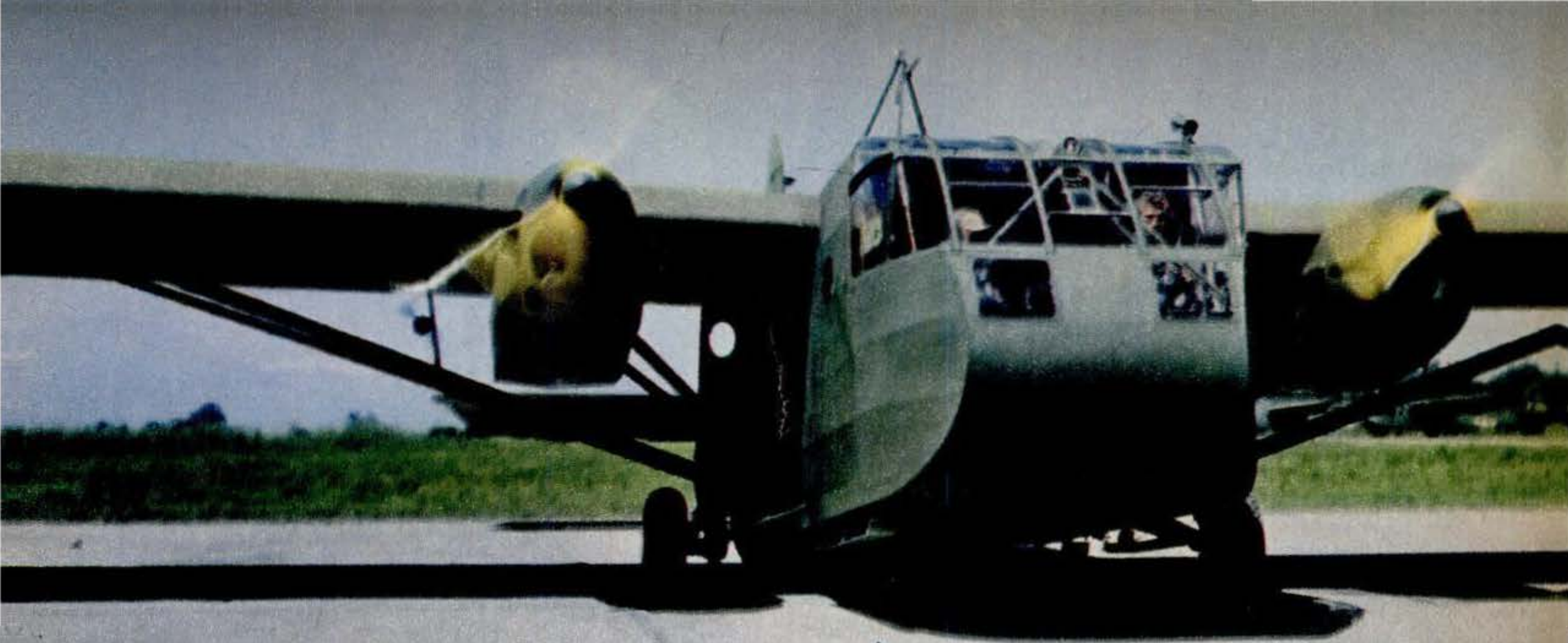




CG-4A is the U. S. Army's standard troop and cargo-carrying glider. With a wing span of 83 feet 8 inches and over-all length of 48 feet, it weighs 4,700 pounds unloaded and carries a payload of about 1½ tons. Fifteen men, counting the pilot and copilot, can ride in its broad fuselage and come out fighting when it lands

Pilot and copilot occupy a fully equipped cockpit in the blunt nose of the CG-4A. A broad, high window gives them full vision of what is going on in the air and on the ground during a tricky landing in enemy territory. In this photograph, the pilot is operating the lever that casts off the towline and releases the glider



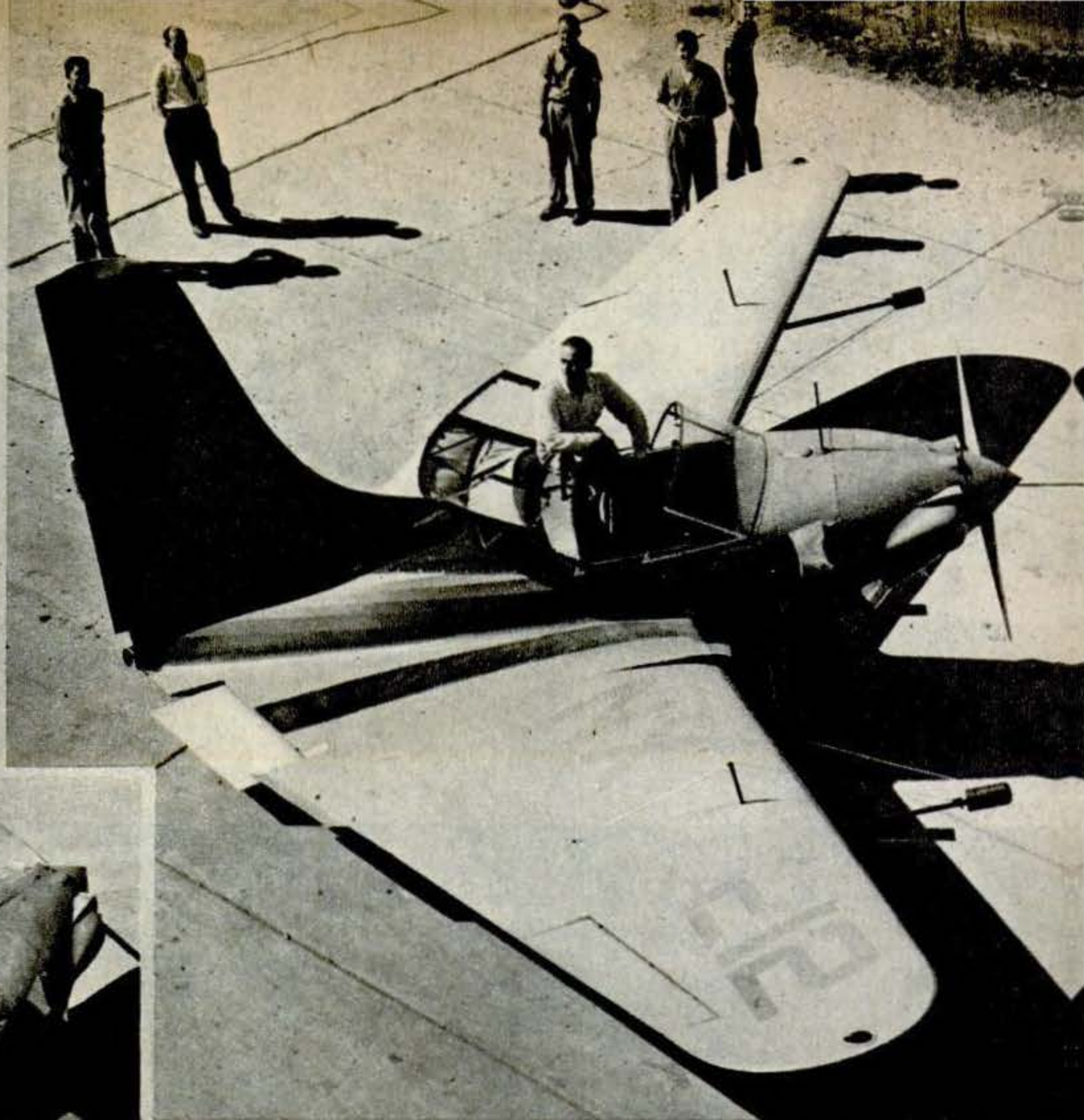


"PIG" is the Army's nickname for the powered glider, a hybrid craft produced by mounting detachable engines on a standard glider type. This is the PG-2, a CG-4A fitted with two 175-hp. air-cooled engines that can drive it at 100 miles an hour for delivery from factory without towing or knocking down

Landing gear consists of a pair of small wheels, which, on some models, can be dropped by parachute after the take-off. These are supplemented by a set of skids resembling sled runners, seen under the nose of the CG-4A below. The tripod on top is part of the mechanism for lifting the hinged nose

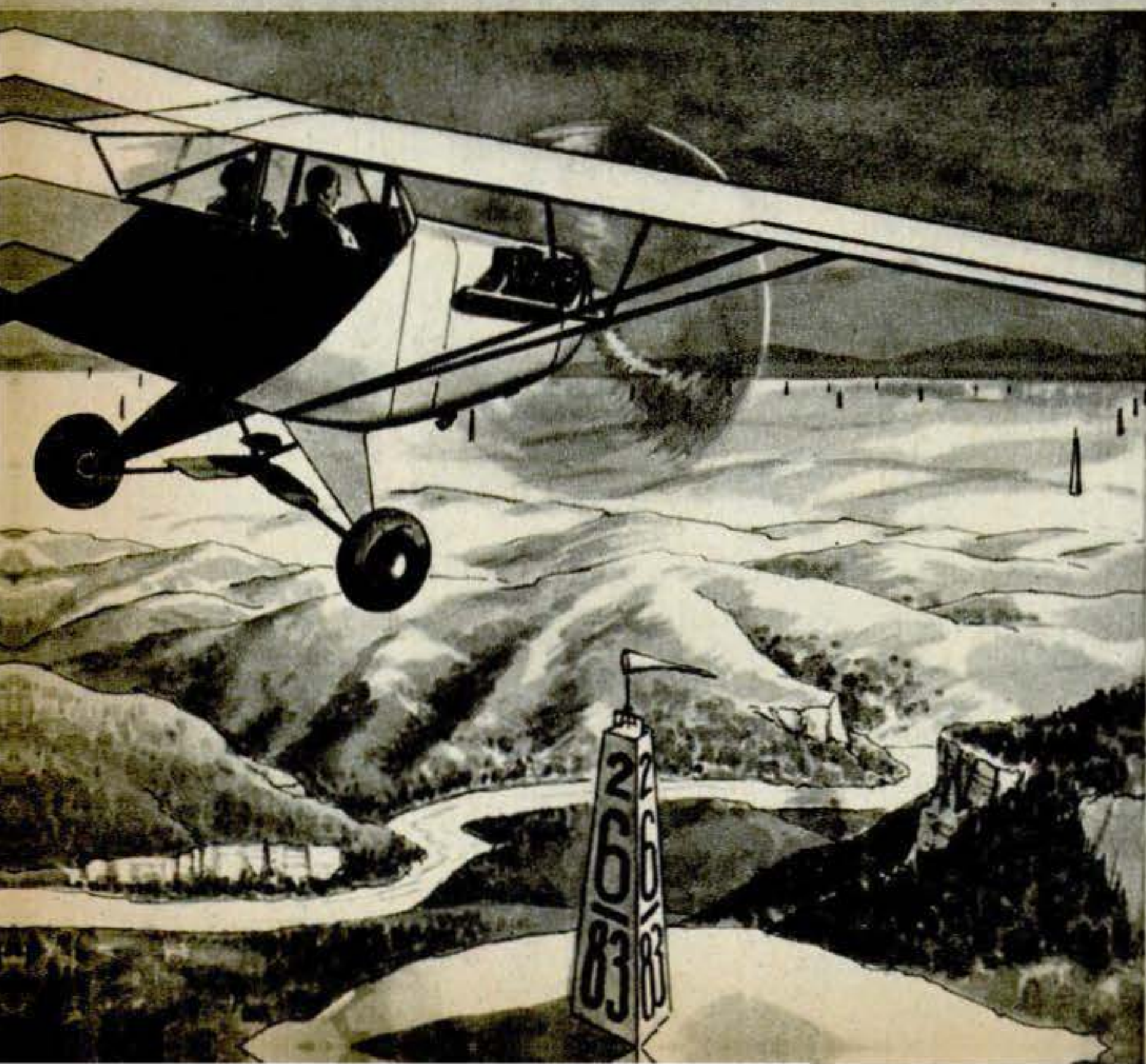


A "BAT PLANE," whose movable wings adjust themselves during flight to keep the craft from stalling or going into a spin, was recently demonstrated at the Dayton, Ohio, municipal airport. Operated by the control stick and held in ball-bearing sockets, the moving wings also help to keep the fuselage steady by absorbing air bumps. Other novel features are V-shaped wings, a nine-foot tail, and the elimination of elevators and horizontal stabilizers.



Because of priorities, Mallard carries overlight engine. Weights extending from wings were, therefore, used during tests to move center of gravity forward. Left, convertible cockpit covering is shown drawn up

The ship, known as the Mallard, was developed by George Cornelius, president of the Cornelius Aircraft Corporation, of Dayton. It is 17 feet long, has a 30-foot wingspread, and is said to be able to continue in normal flight even after the pilot has removed his hands and feet from the controls.



FLYERS' SIGNPOSTS. To simplify navigation for the thousands who are expected to fly their own planes after the war, Prentiss Cleaves, experimental test pilot for the Cessna Aircraft Co., of Wichita, Kans., suggests dotting the United States with markers set at intervals of 10 nautical miles to indicate the latitude and longitude of a plane's position. These markers would be 100-foot pylons painted orange so as to be plainly visible, and would carry huge numbers showing latitude and longitude in minutes. By noting the numbers on the nearest pylon, and then referring to an aeronautical map showing the locations of these markers, a pilot could quickly determine his position.

Quick Daily Workout Guards Your Health

WHETHER you work in an office or a war plant, exercise in regular but moderate doses is as necessary to your health as a good diet. If you have a sedentary job, it will tone up your little-used muscles. If you are active most of the day, it will refresh those muscles that have become tired. Ramsey Ames, Universal Pictures actress featured in "Ali Baba and the Forty Thieves," shows you a 15-minute workout that you can take in your own bedroom. Take it easy at first, and then gradually work harder and harder at these exercises as you feel yourself limbering up. After each workout, lie down with your feet slightly higher than your head, and relax for 10 minutes



FOR UPPER BODY, hook fingers above the head, and alternately pull the hands against each other and relax. Do for only two minutes. Excellent for arms, chest, back, and shoulders



FOR BETTER POSTURE, a good exercise is to stand with heels 18 inches from the wall, reach back and touch the wall, and raise and lower the body on the toes. This develops the muscles of arms, legs, back



LEGS AND HIPS can be given a good limbering up by rolling yourself up on your neck and then working your legs as if pedaling a bicycle



ABDOMEN AND BACK can be exercised by lying with heels on edge of chair, and raising and lowering the body from the floor to position shown



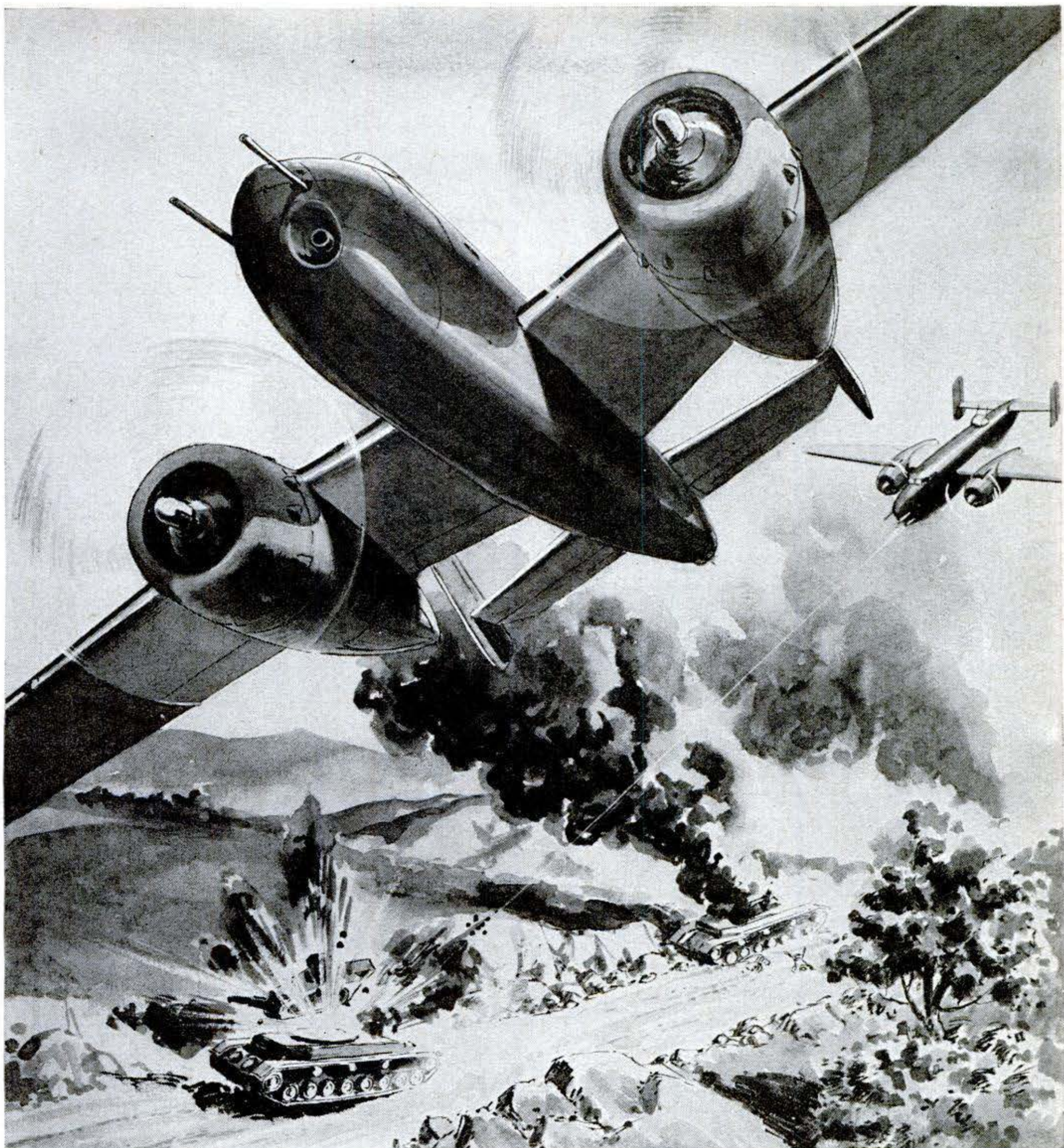
FOR HEROISM. This is the approved design of the Navy and Marine Corps Medal authorized by Congress on August 7, 1942. Awarded to "any person who, while serving in any capacity with the United States Navy or Marine Corps, including Reserves, shall have, since December 6, 1941, distinguished himself or herself by heroism not involving conflict with the enemy," it ranks immediately after the Distinguished Flying Cross among Navy decorations (P. S. M., July '43, p. 56). The ribbon is worn in lieu of the medal itself.

A COLOR INDEX that aids in finding colors that match or harmonize has been brought out by the Container Corporation of America, of Chicago. Each of the index's six bakelite containers holds 14 celluloid cards, on each of which are eight removable plastic chips of harmonizing colors. The index also includes two work charts on which the chips can be placed, either in a circle or in a diamond-shaped arrangement, for purposes of comparison. The full range of the index is 680 colors.



THE "DRY GUILLOTINE" does the opposite of making a soldier lose his head. It teaches him to keep it, and to hold it low when crawling into enemy territory under fire. Known as an infiltration trainer, the device has numbered vertical pegs that swing to a horizontal position when touched by a soldier who does not hug the ground closely enough. The trainee's score is computed by adding the numbers on the pegs he has tilted while crawling under the "bullets." A motto on the wicked-looking gadget gives this grim advice: "The higher your score, the deadlier you are."





Packing the biggest guns ever mounted successfully in aircraft, North American B-25 Mitchells are now blasting enemy tanks, ground installations, and warships with shells of full field-artillery caliber

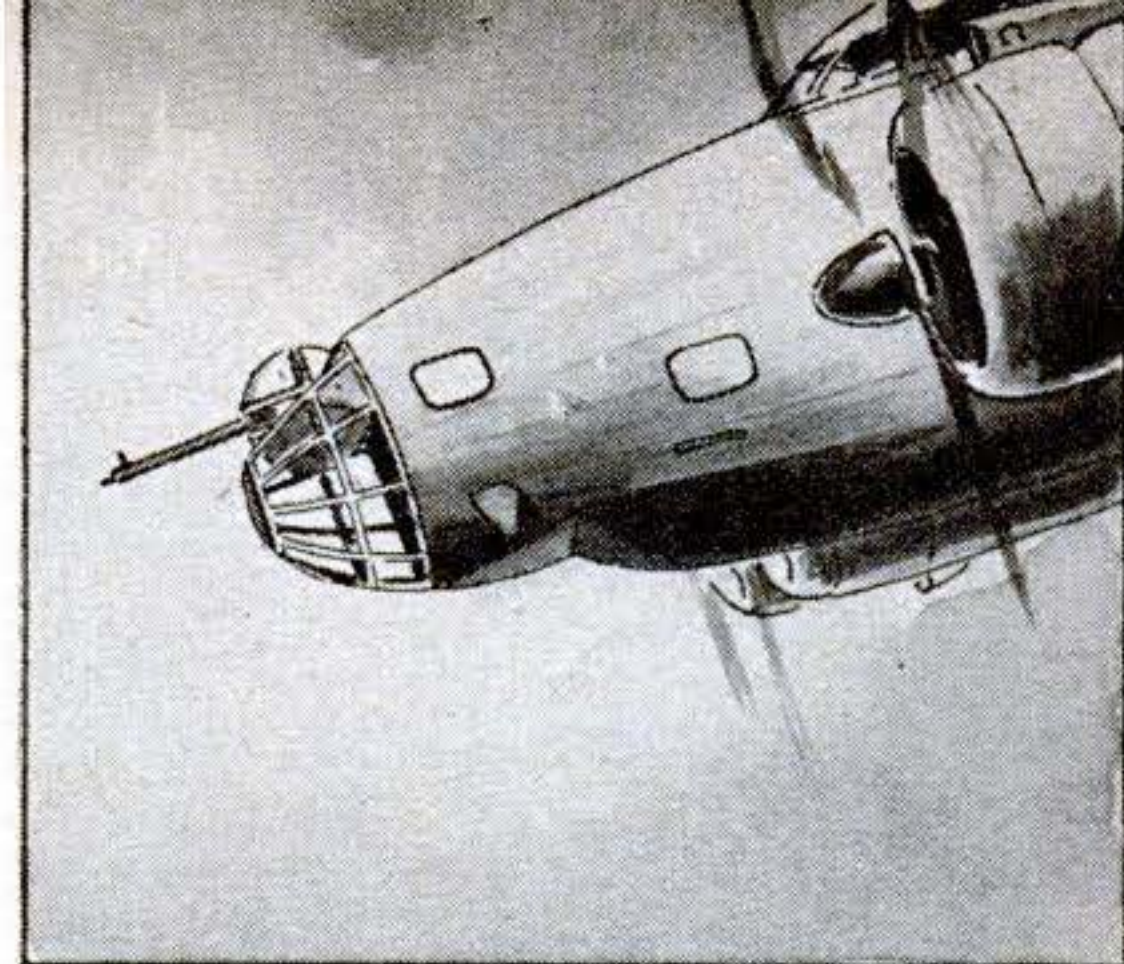
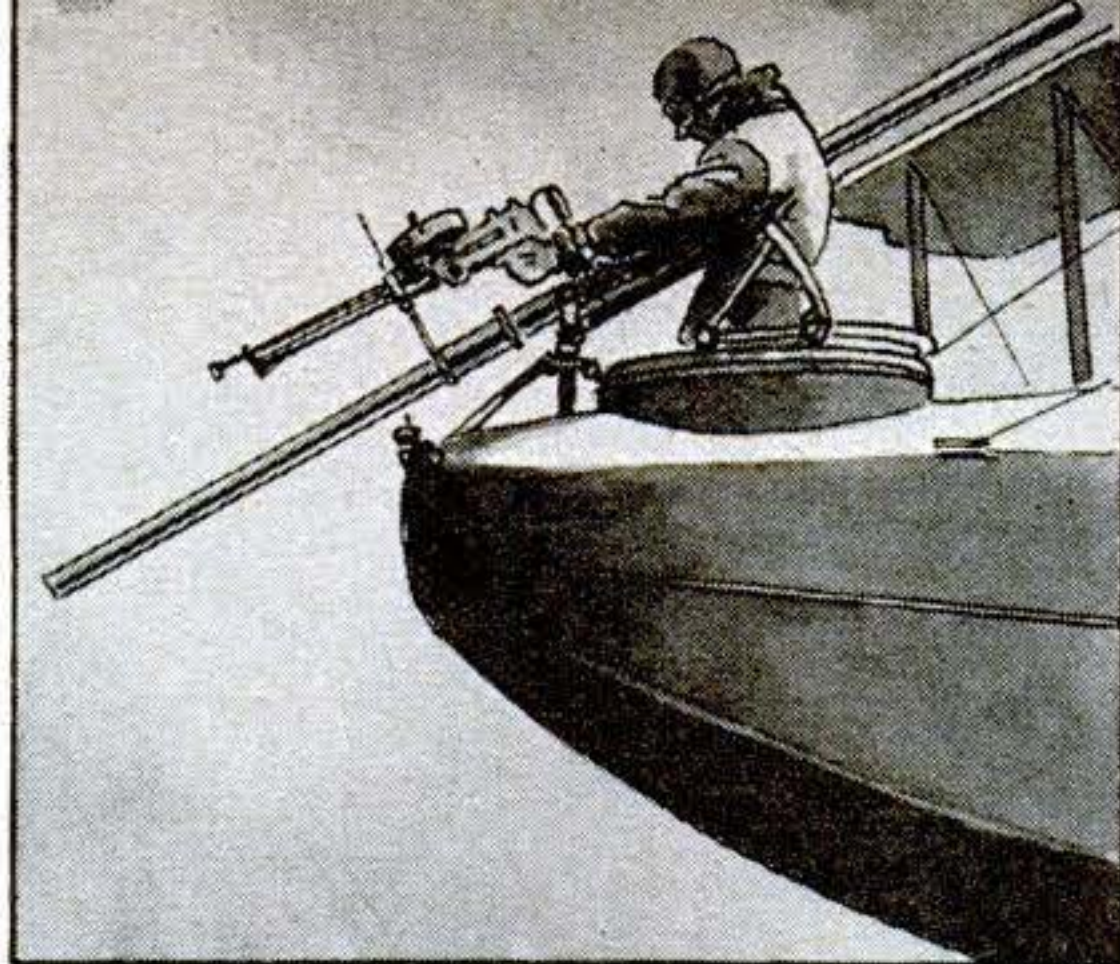
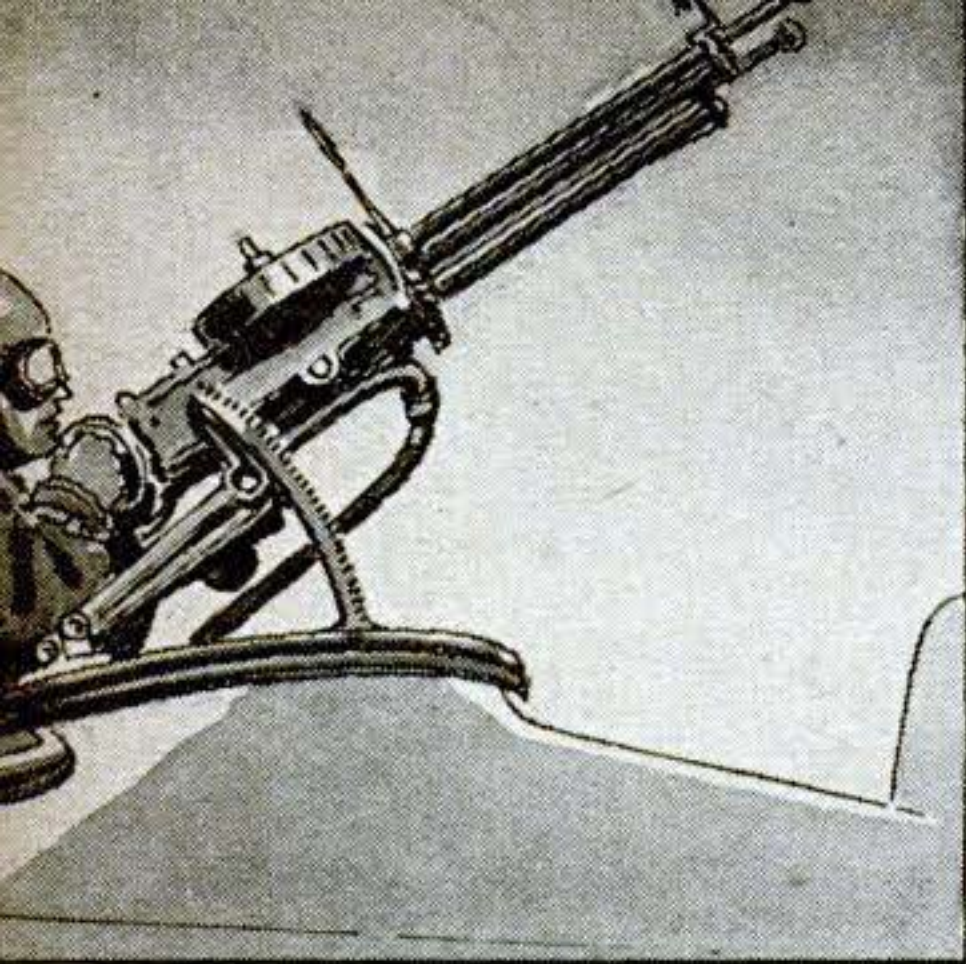
AMERICAN planes now carry the aerial firepower to back up *any* plans our strategists may have for future air offensives!

Firepower, the peg on which air superiority hangs, has suddenly taken on new meaning for American planes and pilots. The reason is the achievement of a little group of Ordnance and Air Corps experts who have made a World War I dream come true—the dream of carrying aloft in aircraft regulation fieldpiece-caliber artillery.

Since the days of the Spad, the Camel, and the Fokker D7, the armament of mili-

Flying Big Gun

America gets the world's most powerful air weapon—a cannon of fieldpiece caliber that goes into battle in a combat plane.



HOW AIRCRAFT ARMAMENT HAS GROWN IN SIZE AND POWER

.30 CALIBER machine guns were the first real weapons mounted in planes. They were used universally in the First World War, both in fixed and in flexible mounting

DAVIS CANNON was a World War I stab at heavy caliber. Its strange double barrel, firing both ways, was designed for neutralizing recoil. A coaxially mounted machine gun helped in getting the range

.50 CALIBER machine guns, now our staple of aerial firepower, were first used in our B-17's in 1935. The American Browning in the .50 size has made air history

tary aircraft has undergone few really radical changes. The old .30 caliber machine gun has but recently given way to the .50 caliber gun developed by American experts and used by our pilots and air gunners. The first production air cannon firing an explosive shell was the 20-mm., only slightly larger in caliber than a .50 machine gun. Then came the 37-mm. cannon, around which the Bell Airacobra was designed. Some British planes now carry the 40-mm. cannon, only slightly larger than the Airacobra's weapon. These guns have proved highly effective, but our Ordnance men still dreamed of arming a plane with a weapon such as the most-used fieldpiece of World

War I, the French 75-mm. cannon.

Not until mid-November 1942 did their plans bear fruit. The setting was far out in the Pacific, off the California coast. A plank-and-fabric target bobbed in the surf directly in the glide path of a North American Mitchell bomber.

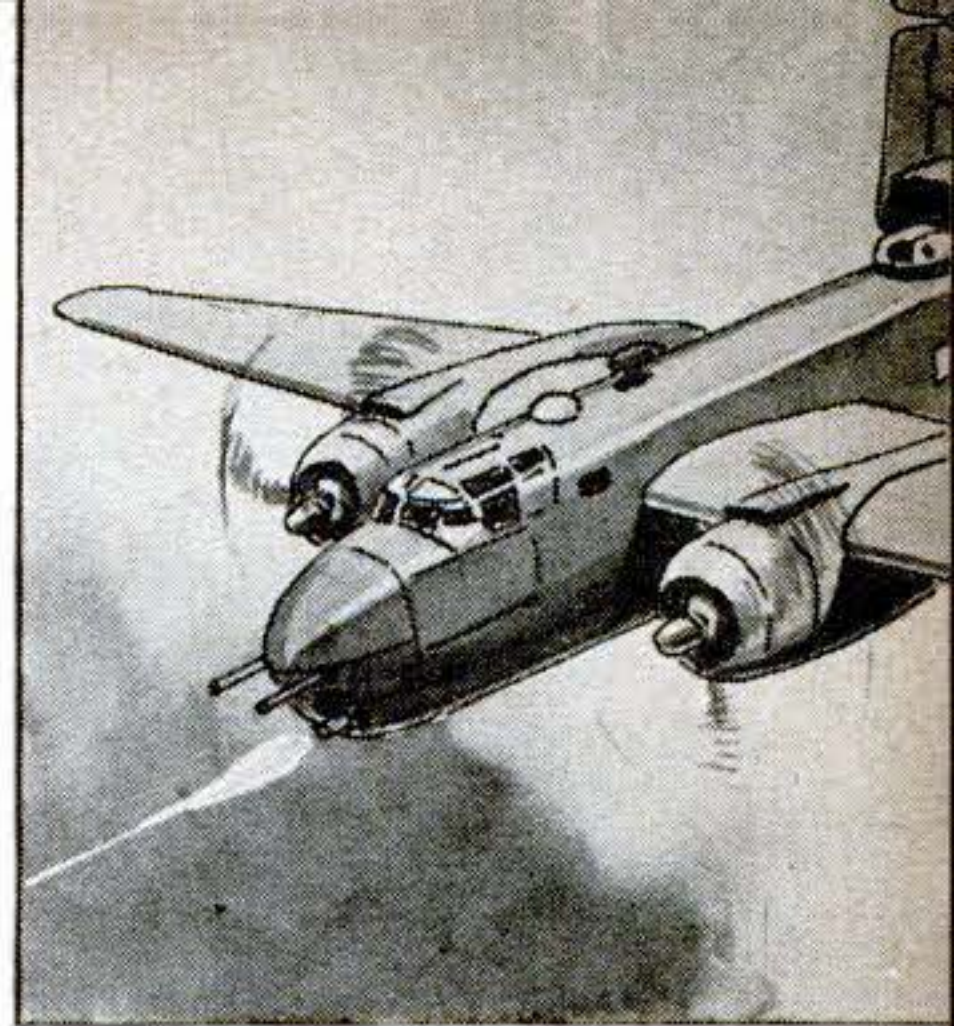
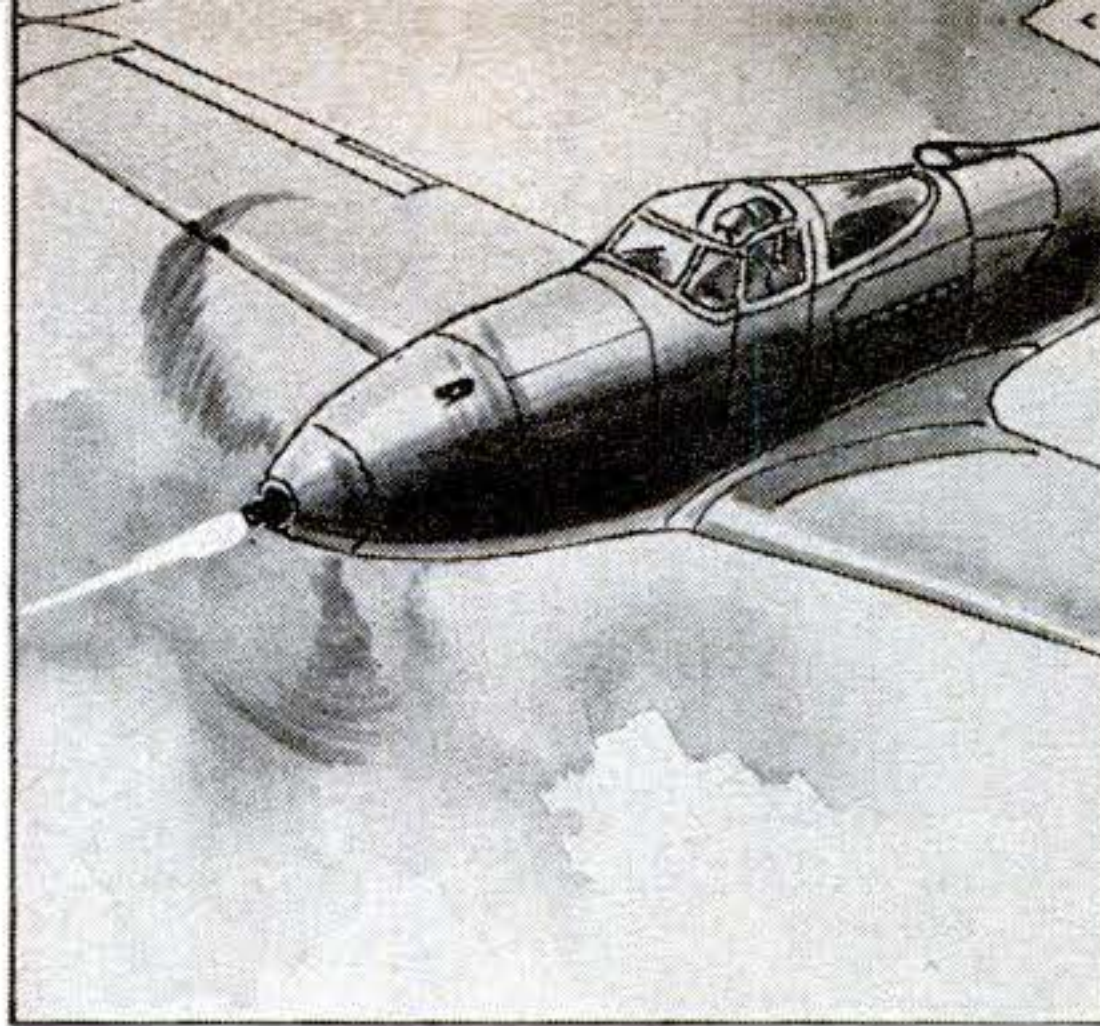
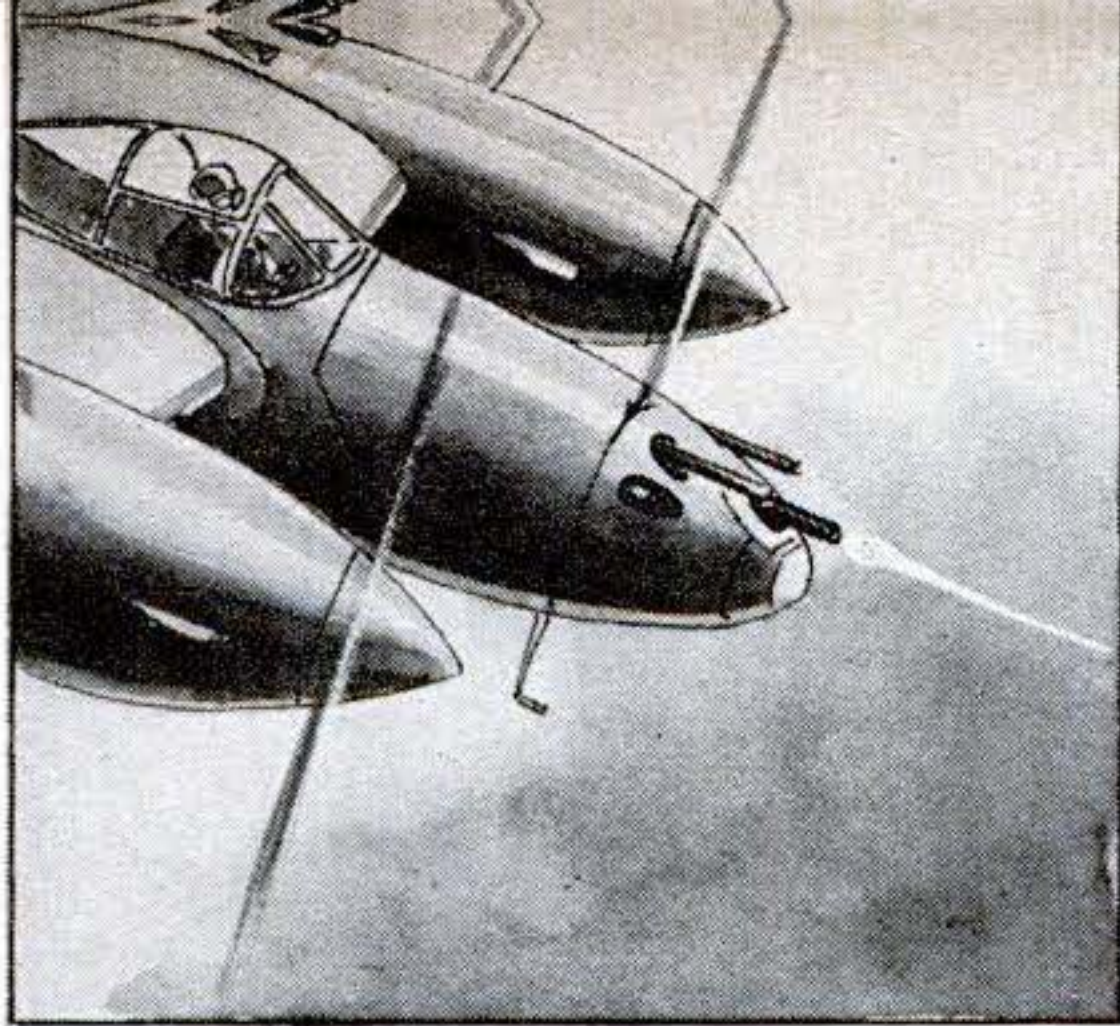
Suddenly, while the B-25 was still miles away, its nose blossomed orange flame. Gulls wheeling about the floating target took no notice, for before the sound of the gun could have reached them, they had vanished along with the target in a great upheaval of debris, water, and froth. America had a new aerial weapon—the world's deadliest aerial cannon, a flying "75"!

THESE TWO MEN HELPED NURSE THE WINGED 75 ALONG



Jack Fox (left), North American Aviation service representative in the South Pacific theater, reported to his company on the manner in which the Mitchells stood up under the shock of big-gun fire in the early missions with the 75. Roger Rudd, below, is the test pilot who ushered in a new era in aerial firepower when he tried out the first B-25 installation off the coast of California. By a strange coincidence, he had been chief of a gun crew handling a 75 in World War I





FROM THE DAYS OF WORLD WAR I UP TO THE PRESENT

20-MM. CANNON. This caliber, a favorite with foreign air powers, was put into our Lightning P-38 in 1941. It was the first air gun to fire explosive shells

37-MM. CANNON. Until now the second-largest aircraft gun (the British have a 40). The P-39 Bell Airacobra was literally designed around a specially built 37 with several machine guns

75-MM. CANNON mounted in the B-25 Mitchell medium bomber marks the realization of an air-ordnance dream—a gun of fieldpiece caliber borne aloft

In the cockpit of the Mitchell, lanky Roger Rudd, North American test pilot—and, by a coincidence, a 75-mm.-gun crew captain in the World War—relaxed his finger from the red button on his control wheel. With a grin he spoke through his throat mike to the ground:

“Rapping off over 200 in a mild glide . . . good husky jolt . . . scarcely any noise . . . she doesn’t decelerate a damn bit!”

That was Rudd’s report on the first production-model test of our new flying artillery.

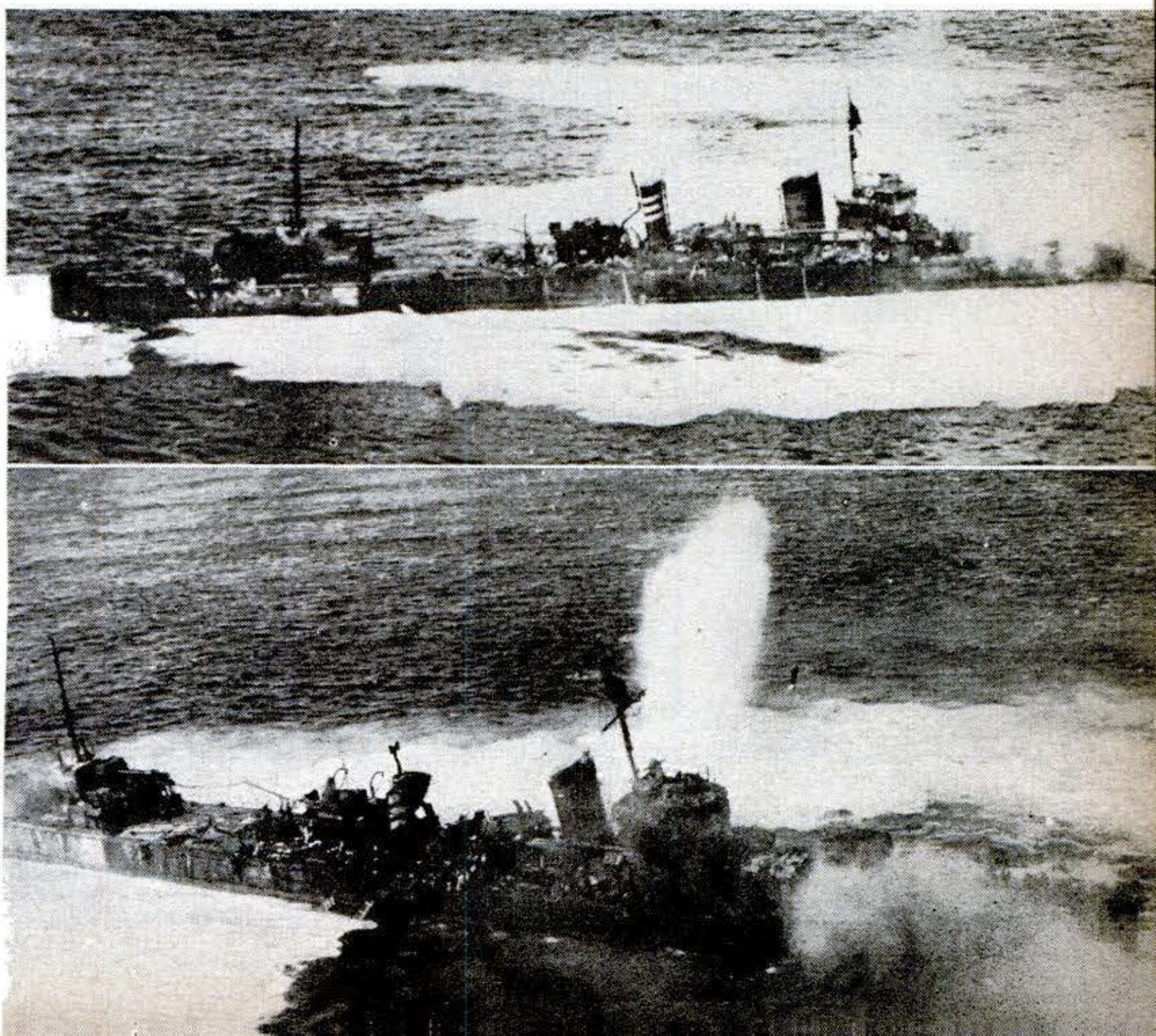
Since this first flight, the flying 75 has appeared in ever-increasing numbers in the South Pacific and probably in other theaters. Its pilots came back from first missions with combat reports that read like pulp fiction, and with awe at what the new weapon had done.

One cannon-carrying plane on its first mission destroyed a Nip transport as it was unloading, and with one shell ended the earthly worries of 15 Japs scurrying up the beach. On its second mission it ploughed five shots into a large Jap destroyer, hitting the

aft turret, bridge, amidship section, and bow. Another run on it—now beached—plastered a stack, the bridge again, and the deck, and set off internal explosions. The third mission resulted in the blasting of runway strips and ground Jap planes, along with the silencing of reinforced pillboxes. The cost of all this was 90 rounds of ammunition and a few holes from flak.

Other planes flying the 75 had similar success, and pilots were jubilant over its effectiveness against any type of ground installation or mechanized equipment. One shell would completely destroy a light tank or put the heaviest out of commission. It was equal-

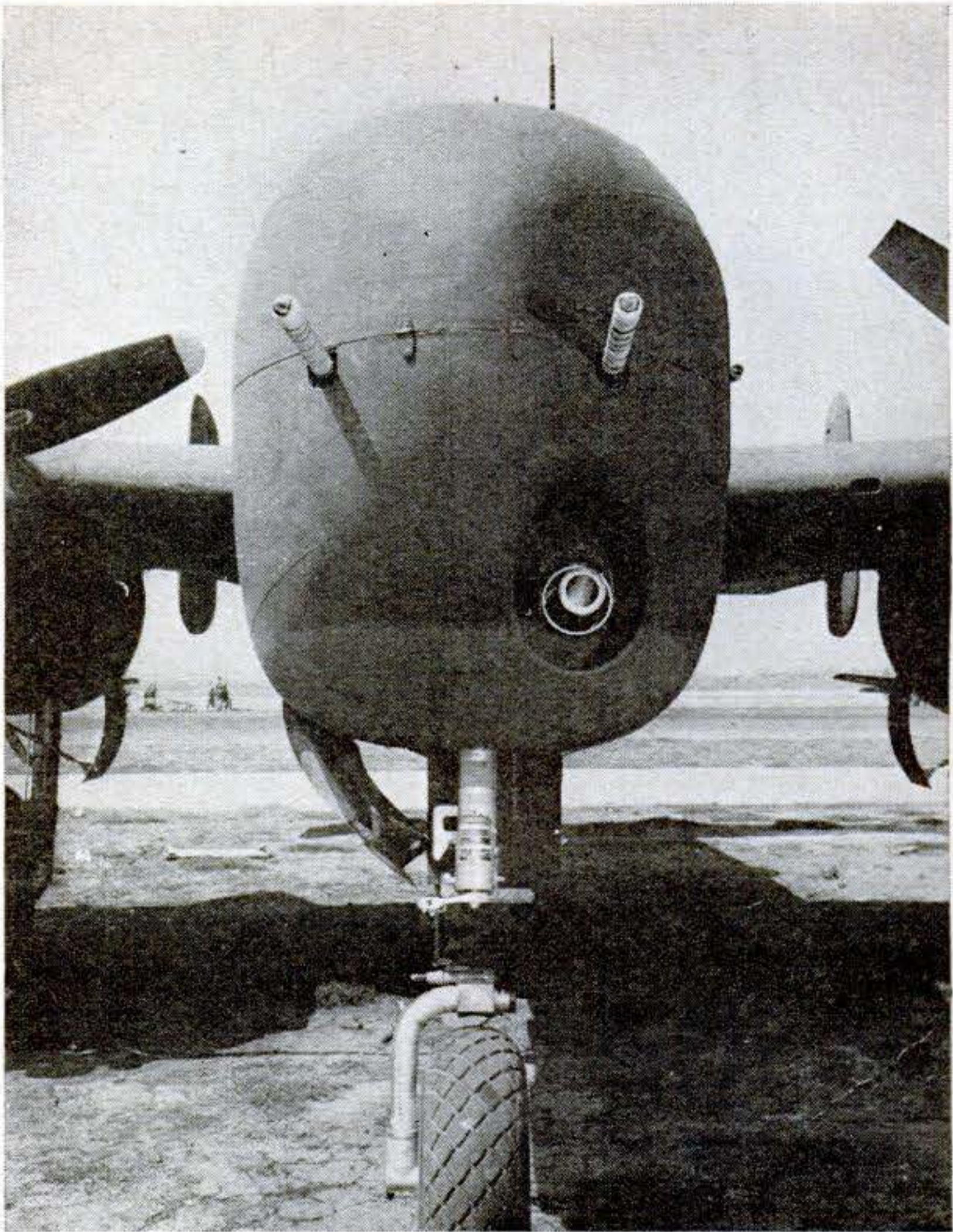
A JAPANESE WARSHIP GETS A SAMPLE



This destroyer felt the might of the new aerial weapon when caught in a hail of 15-pound projectiles in the Pacific. The lower photo shows how she looked when the 75 got through with her

ly deadly against landing barges, ammunition dumps, locomotives, and power plants. The 75 has a range roughly the same as that of the original French 75, with the advantage of being fired from an elusive platform moving hundreds of miles an hour through the air. Such a gun, hurling 15 pounds of concentrated destruction from any angle in surprise attacks, does nothing to calm the nerves of the enemy, no matter how battle-tested.

Even in World War I, a few experiments were made with heavy-caliber ordnance mounted in aircraft. One of the outstanding attempts was the Davis gun, a weird weapon that fired through both ends of the barrel. From one end came the projectile, while



WHAT THE 75 THROWS

FIFTEEN pounds of steel and high explosive are hurled by the winged fieldpiece at every shot. Complete shell, including projectile, case, and propelling charge, weighs 20 pounds and is 26 inches long. Below, a comely North American Aviation worker displays the new Jap chaser.



Shell for the flying 75 is compared below with those of other guns used in aircraft



The big gun frowns from a concave port in the lower left corner of the metal-clad nose section. Two .50 caliber machine guns are auxiliary armament

from the other roared a charge of lead shot. Sandwiched in between was the powder charge. This crude arrangement was expected to overcome the major obstacle in mounting heavy-caliber artillery in aircraft—recoil. The Davis gun did overcome recoil quite effectively, but the back charge of shot had to be reckoned with when placing the gun aboard, and the two-way shell was clumsy to handle. A .30 caliber Lewis machine gun was mounted atop the contraption and fired when approaching the target. Tracers from the Lewis determined when the cannon was within range of its objective, for the range of the double-ended charge was roughly the same as that of the machine gun.

Eventually, the Davis gun was abandoned as an aircraft weapon, and recoil remained a stumbling block until American ingenuity surmounted it many years later.

Shortly before 1939, first tests were made with an old-style French 75 under the direction of Captain (now Colonel) Horace A. Quinn, who was put in charge of the project as Chief of the Aircraft Armament Development Section of the Technical Division, Ordnance, under [\(Continued on page 222\)](#)

Folding bicycles provide transportation for paratroopers where gasoline is not available for the motor scooters (right)



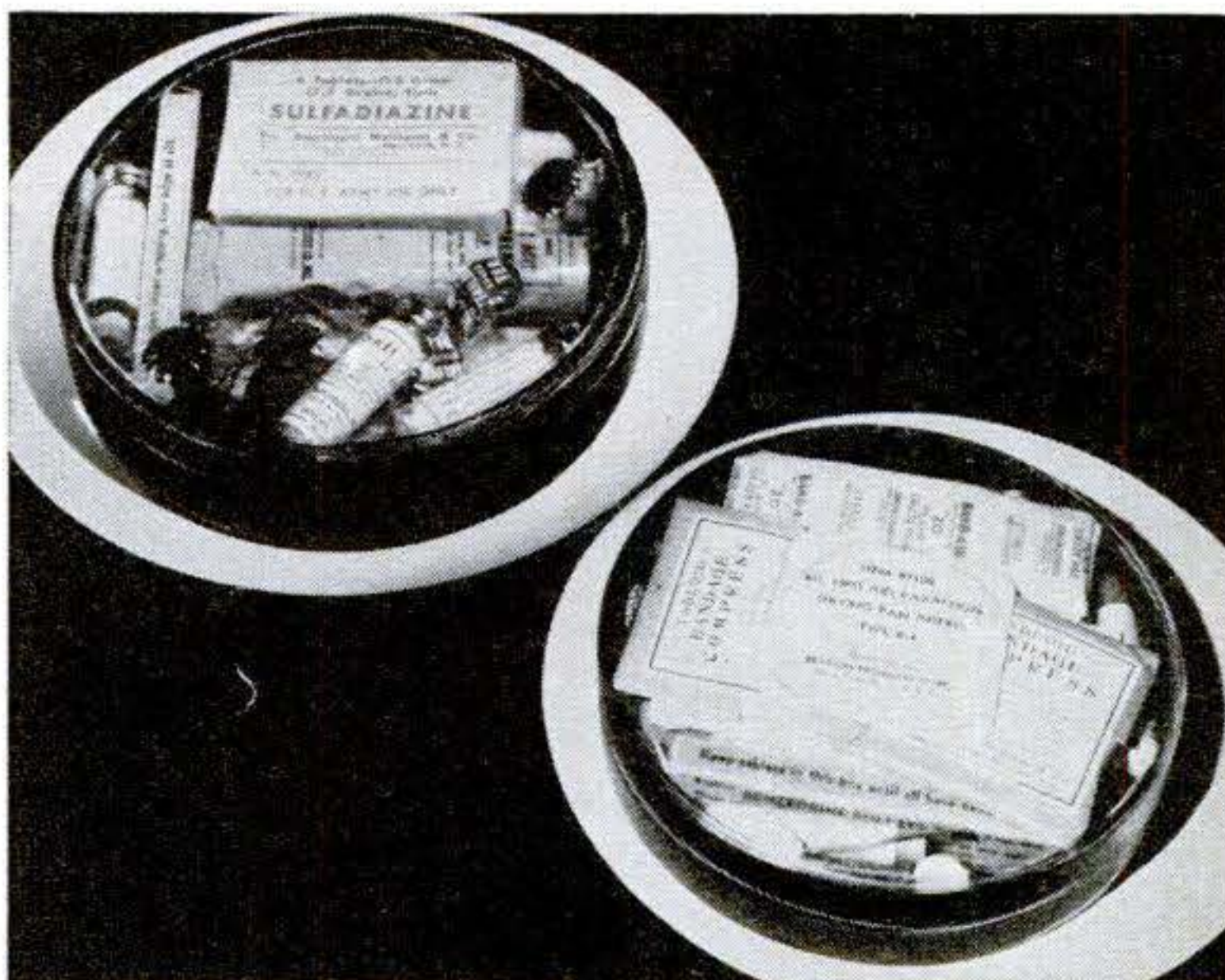
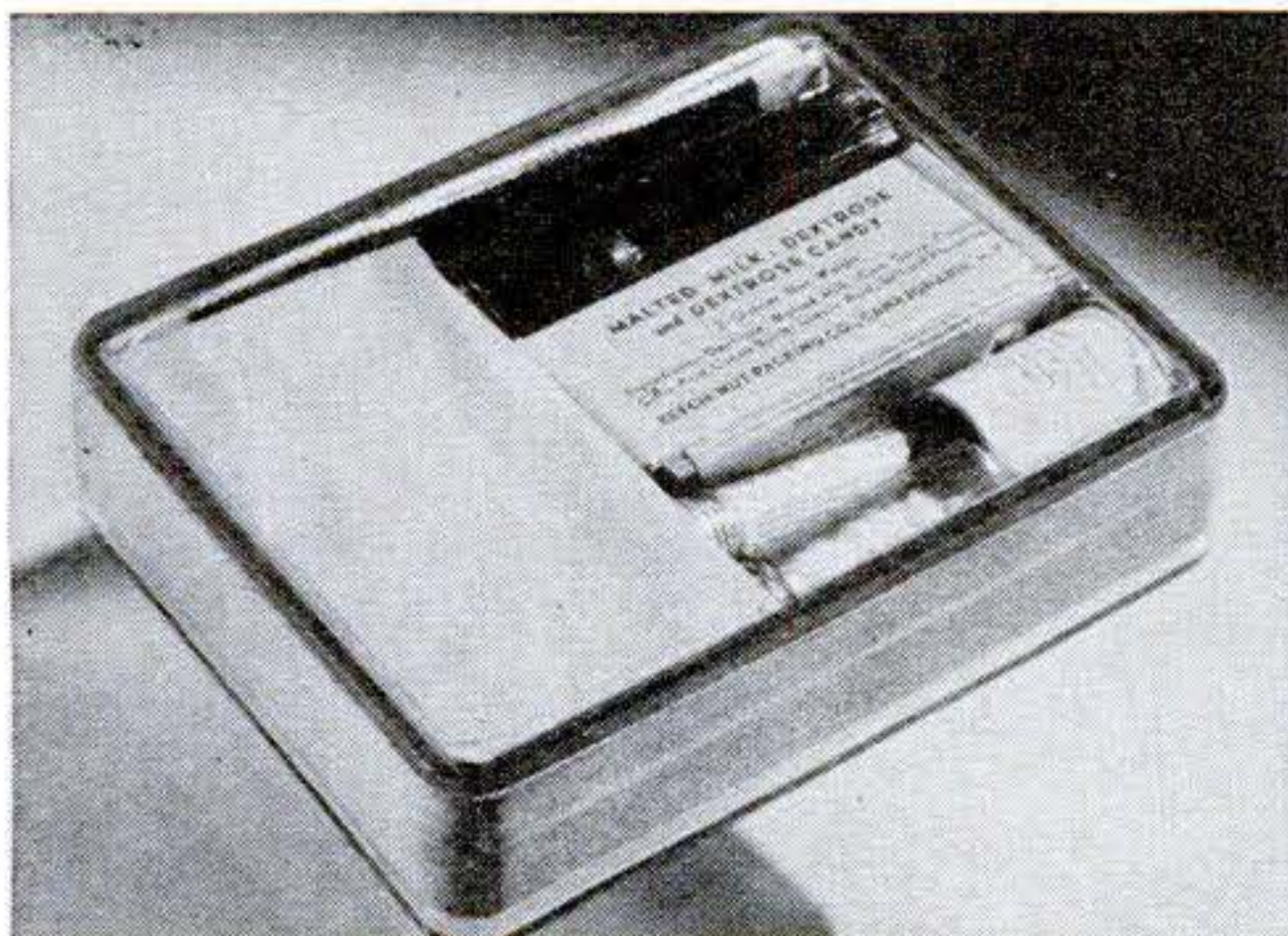
LIGHTWEIGHT motor scooters and bicycles, dropped along with Allied parachute troops, enable the men to go places and do things in a hurry. One man can easily lift the scooter from its container, as shown above. Where gasoline is hard to get, folding bicycles may quickly be unlimbered.

A MIDGET BLOWER, weighing only two ounces, now serves to carry excess heat away from electronic tubes in space-saving war equipment. Alternately, a universal back plate permits the cooling device to be fitted to an electric motor of nearly any design. Despite its tiny size, the blower moves 15 cubic feet of air a minute at 3,000 revolutions a minute. Measuring 1½ inches in diameter, its steel blower wheel is plated with cadmium metal to resist corrosion.



POWDER-PUFF AND GIFT BOXES have been transformed into first-aid and ration kits, to meet the needs of U. S. paratroopers. Adoption of a rigid plastic, and improved mass-production methods, accomplished the urgent change-over. The round medical kit nests within a frying pan,

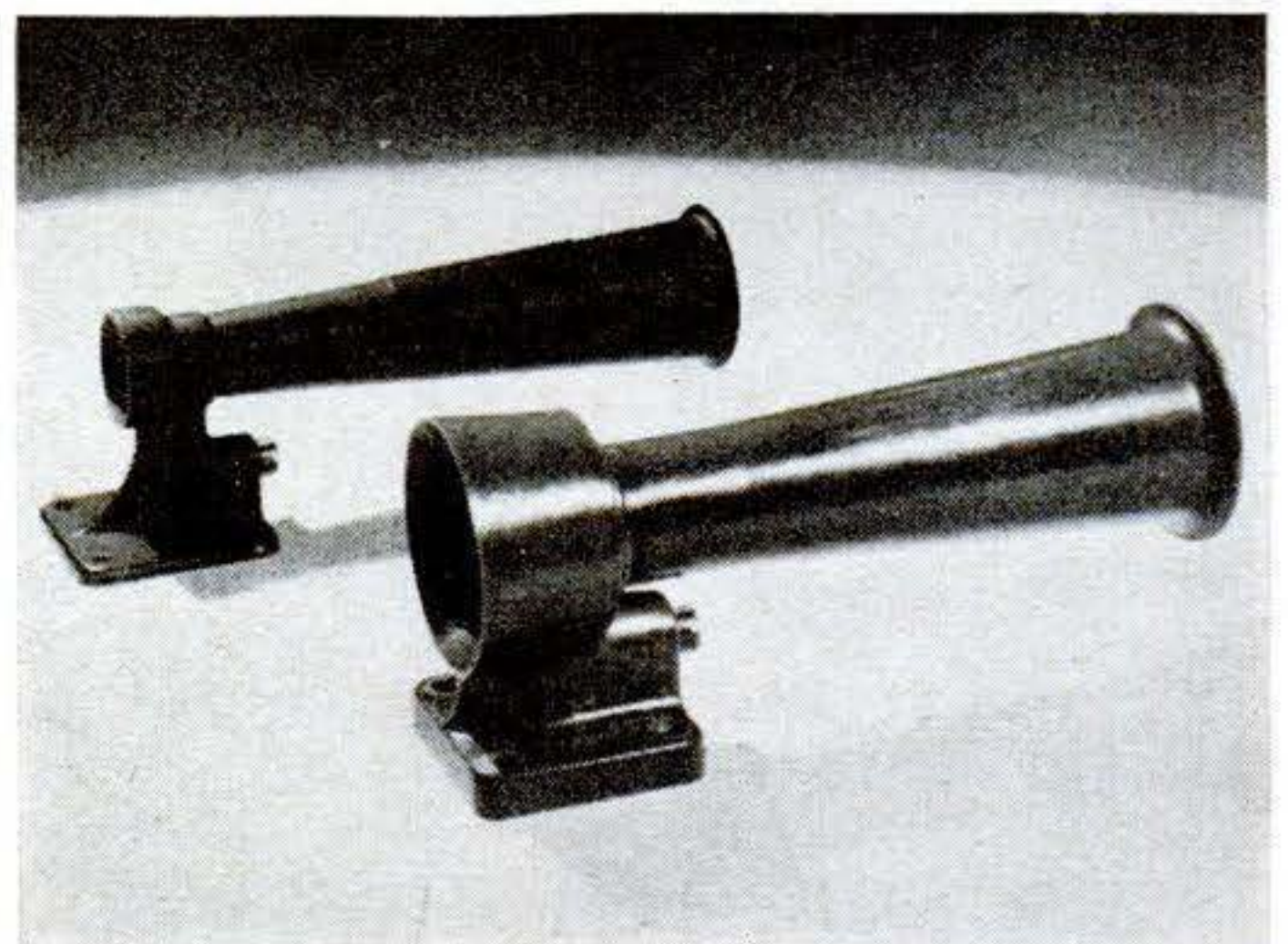
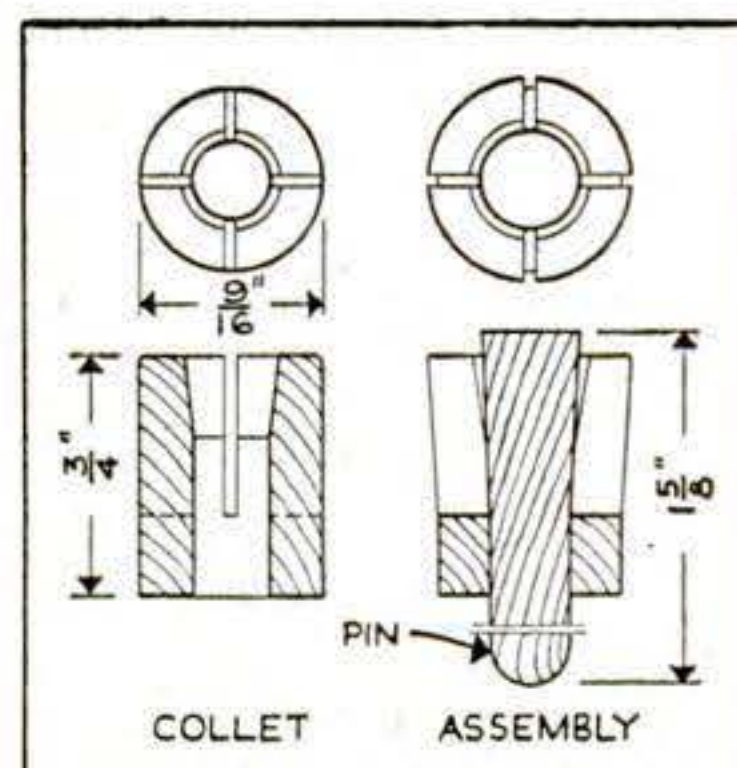
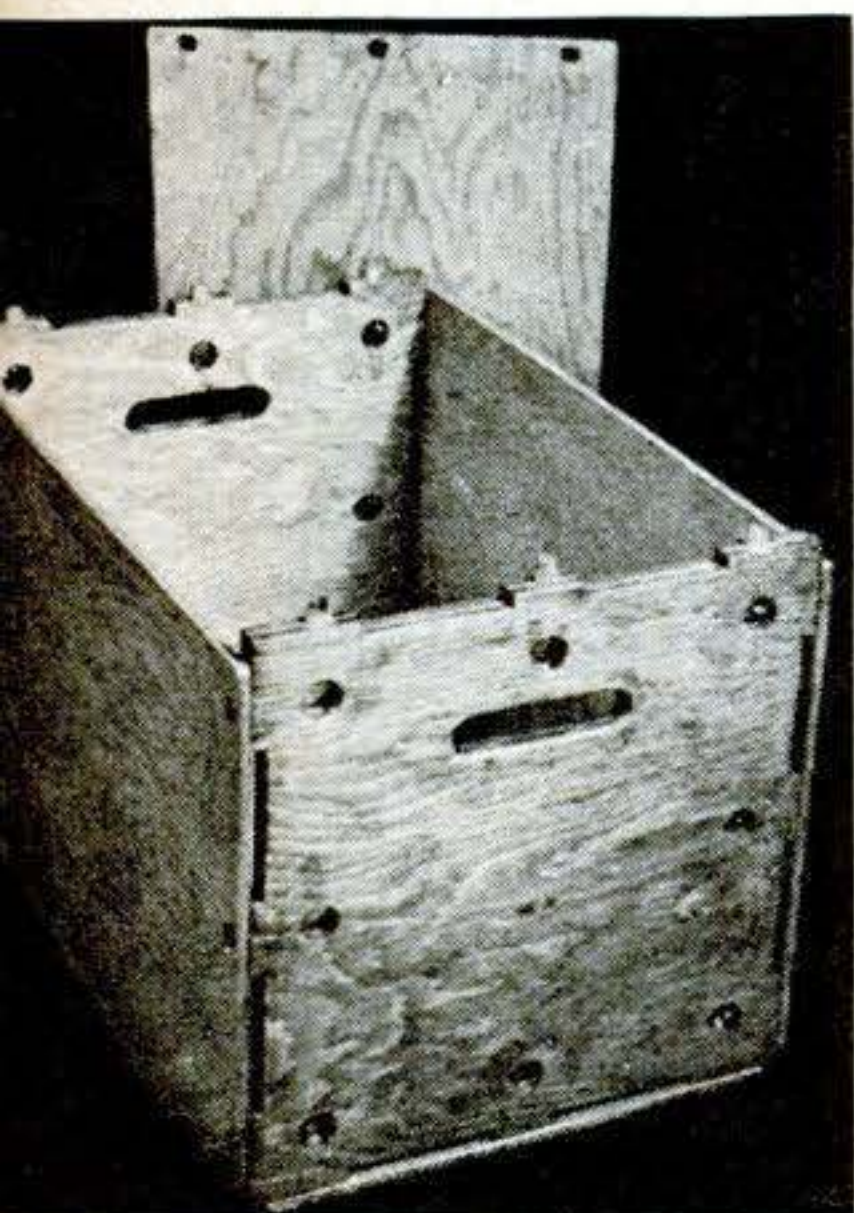
and the oblong ration box contains concentrated food, bouillon powder, a supply of chewing gum, and a water bag.



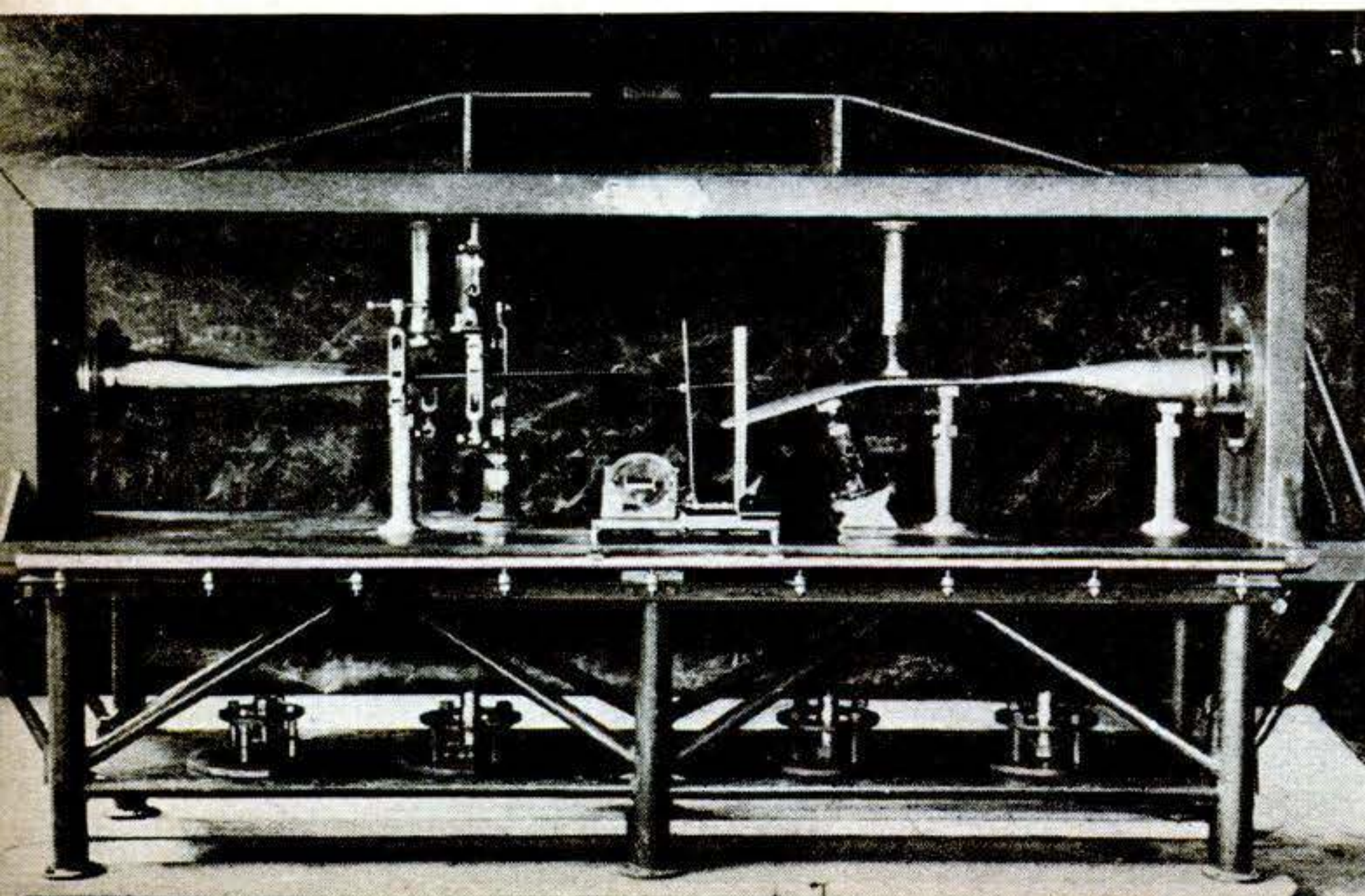


WAR MAPS made from aerial photographs are matched accurately with existing charts by the aid of a new "zenith camera" designed and produced for the Corps of Engineers by the Eastman Kodak Company, Rochester, N. Y. Set up at some recognizable point within the area being mapped, the three-unit outfit is operated at night to photograph the sky directly above the point of observation. Its pictures show the stars surrounding the zenith, together with a record of the exact time of exposure. With the aid of a catalog of the stars, the latitude and longitude of the point of observation can then be computed. Accuracy of the results obtained is believed to be within 40 or 50 feet.

NO NAILS are needed in the assembly of a reusable apple box developed by the U. S. Department of Agriculture. Wooden collets set into the edges of the end pieces fit snugly into holes in the side, top, and bottom pieces. When spread by driving in tapered wooden pins, they hold the box together.



VENTURI TUBES made of plastic instead of die-cast metal are saving weight in our warplanes. They are molded of ethyl cellulose Lumarith by Cruver Manufacturing Co., Chicago. The large tube above replaces the smaller but heavier metal one shown beside it.



BENT PROPELLERS become straight in a "cold straightening fixture" now being used in air maintenance depots throughout the world to keep U. S. air fleets on the wing. Invented by Robert P. Elam, associate aircraft supervisor at the headquarters of the Air Service Command, Patterson Field, Ohio, the device consists of a heavy frame fitted with hydraulic jacks which apply steady pressure on the bent blades to restore their shape.

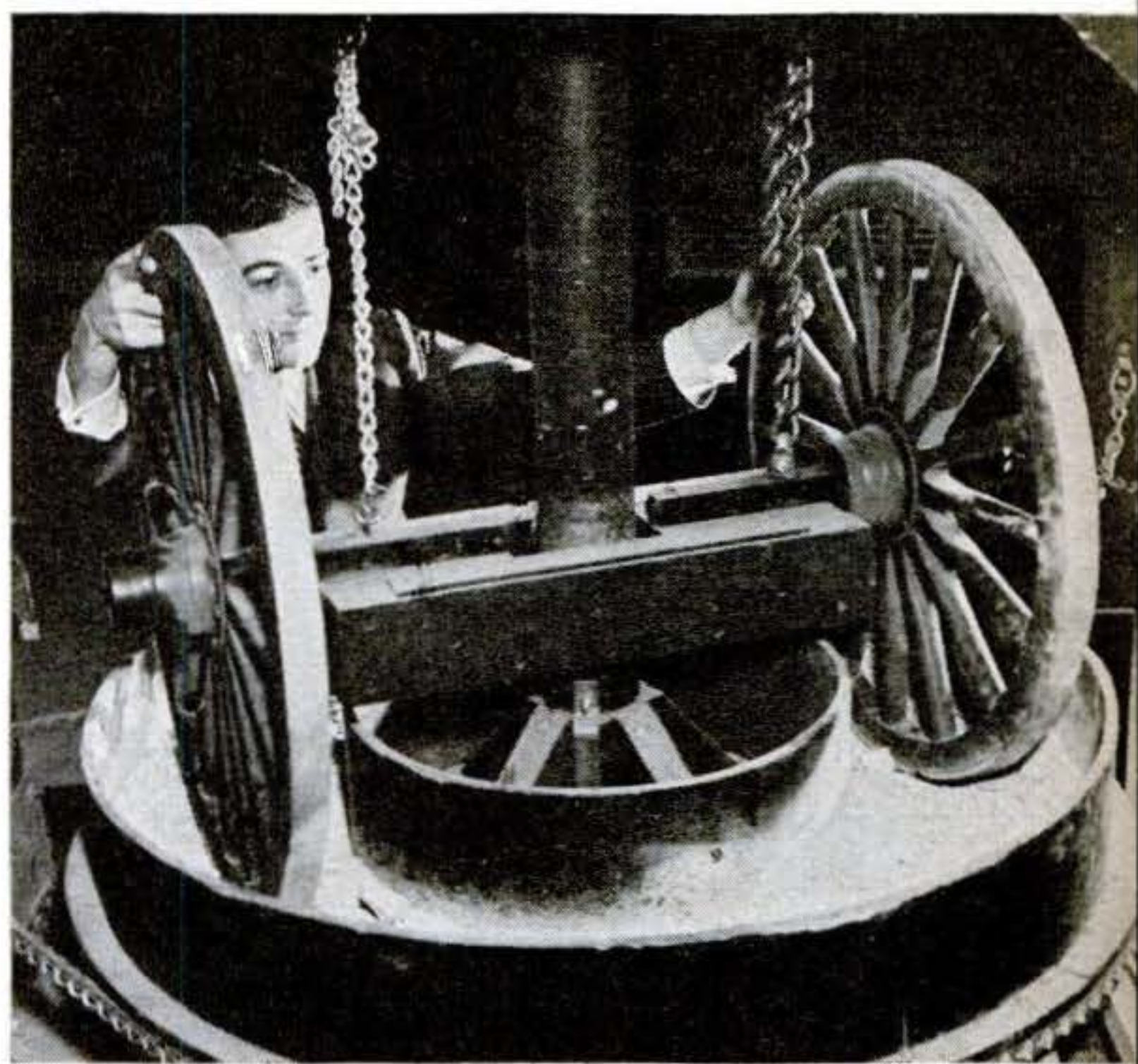
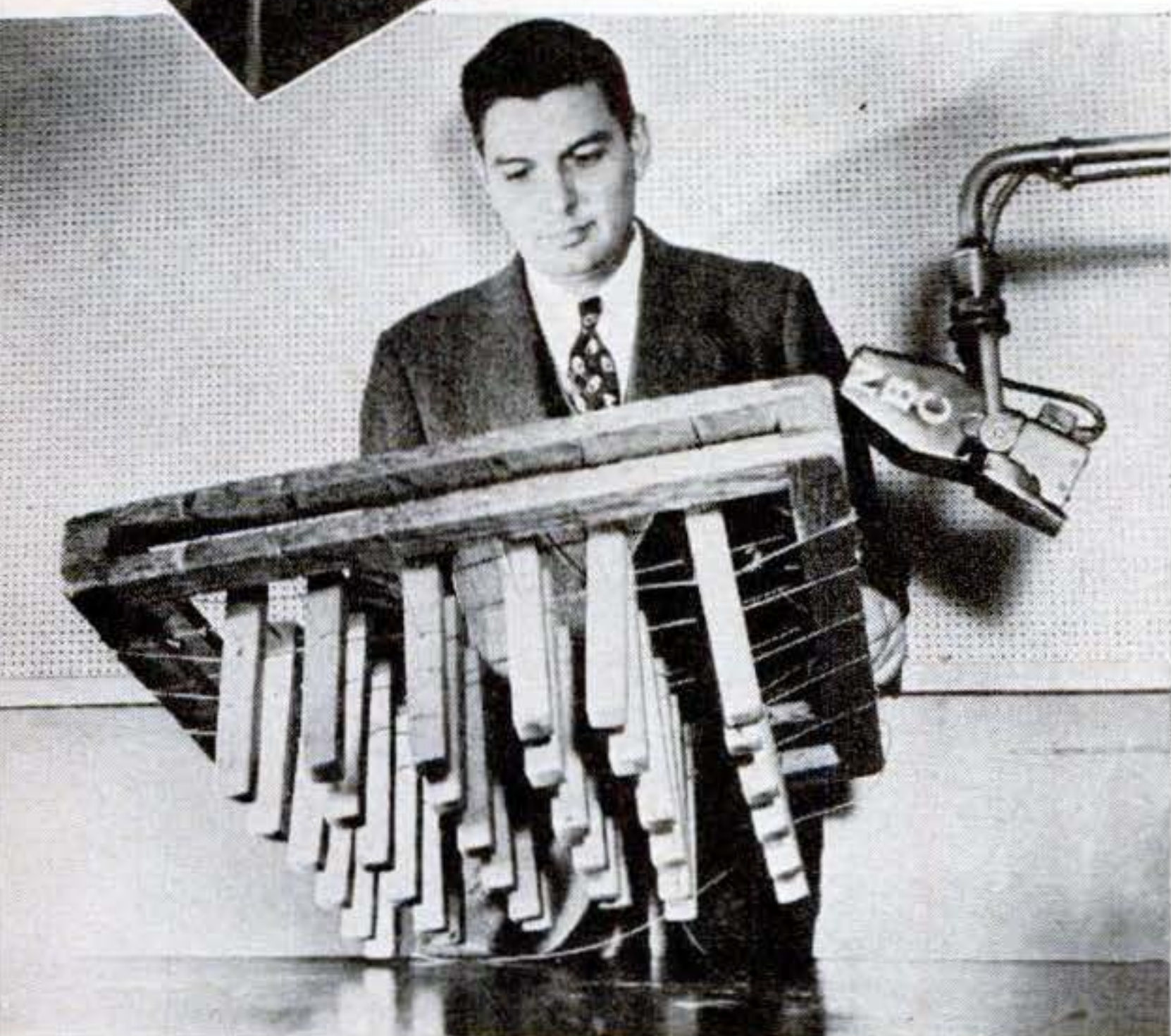
POPULAR SCIENCE



Lifeboat scenes are made realistic by means of a squeaky oarlock that a hard-working sound-effects man turns back and forth

WAR IN YOUR LOUDSPEAKER

Radio Sound-Effects Men Reproduce Din of Battle



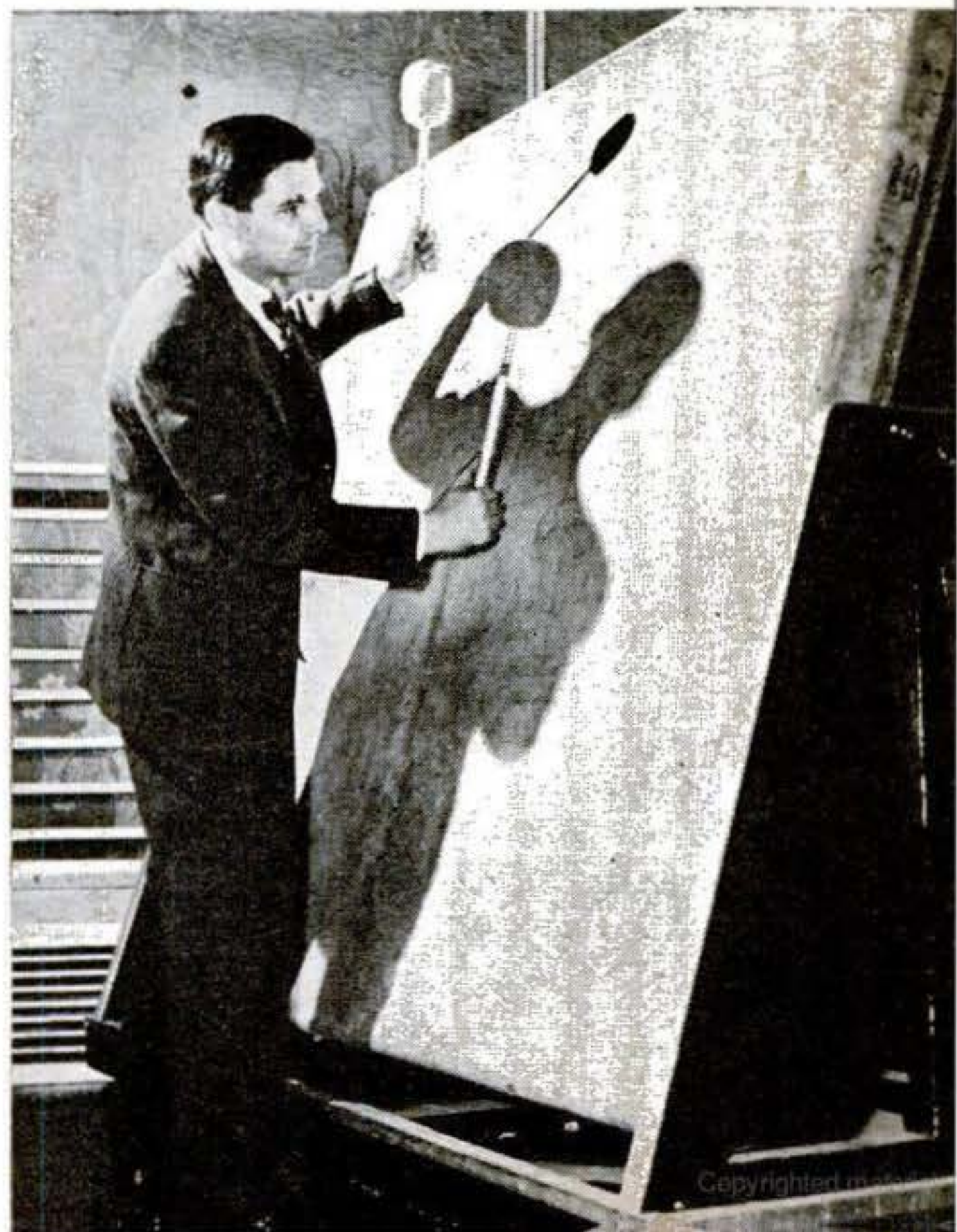
Artillery. If they can't get the right effect any other way, sound men build at least part of the object whose sounds they want to imitate. The wheels above are used to portray the clank and rumble of moving artillery

Cannon Fire is made to boom out from your loudspeaker by pounding on a "drum" (below) whose head is an eight foot square piece of specially treated hide



Marching feet are a commonplace in wartime radio scripts. To produce the necessary sound effect, a studio technician skillfully manipulates the 36 wooden pegs of the device pictured above

Gestapo. To produce the clatter of men forcing their way into a room, this sound man kicks a door vigorously, then rends fruit boxes to portray the splintering of the door panels



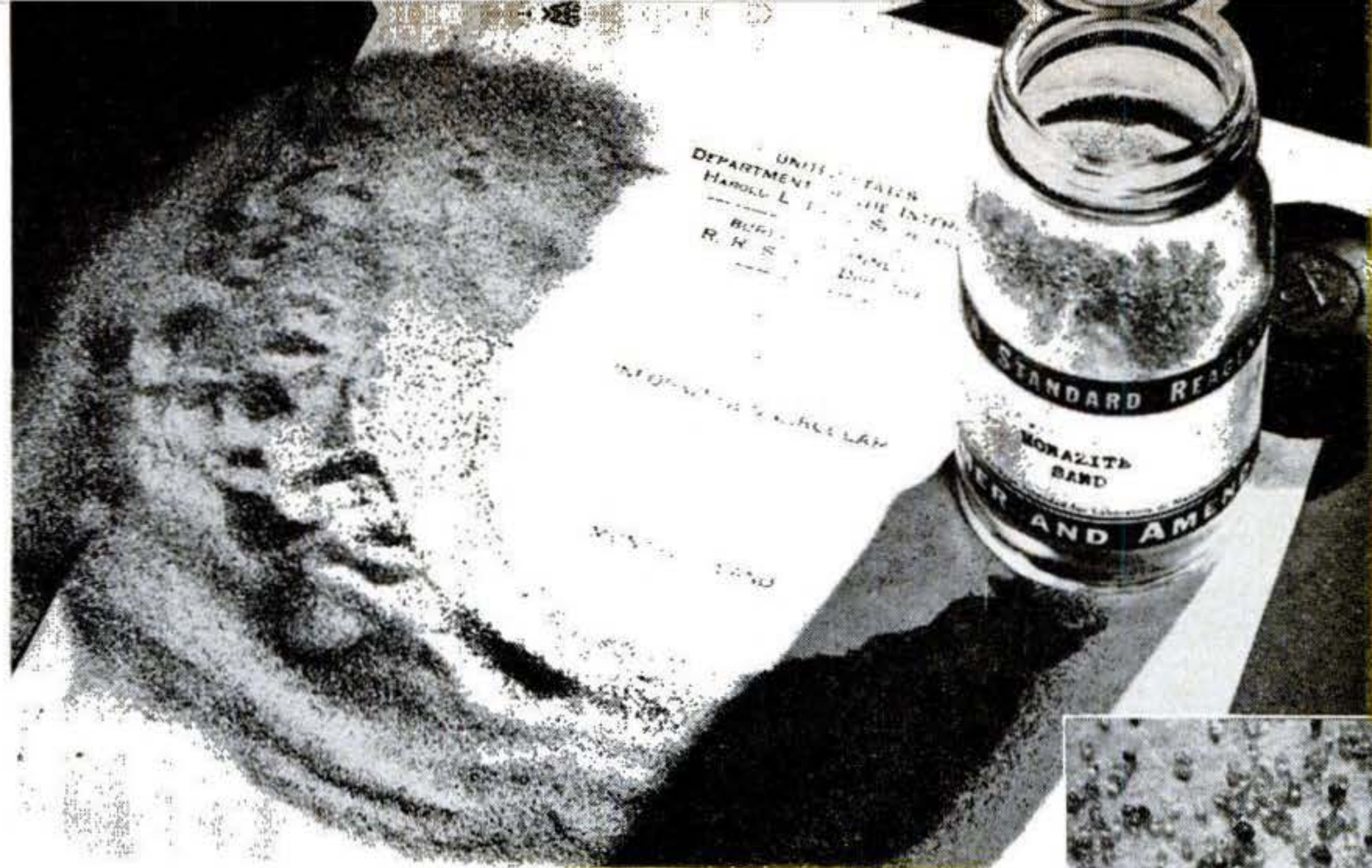
WEATHER PHENOMENA ranging from Eastern sandstorms to Arctic sleet are manufactured by the AAF Materiel Command at Wright Field, Dayton, Ohio. A room specially designed for testing men and equipment under all climatic conditions is provided with blowers that generate wind; batteries of lamps that yield the equivalent of sunlight; a hopper that sends forth clouds of sand; shower heads that pour down rain; and nozzles that spurt water to make fog. Humidity and temperature are also controlled. A rubberized bathtub covering the floor makes it possible to flood the room, creating a small lagoon where soldiers paddle one-man life rafts (right) designed for flyers.



OZONE, an extremely active and germicidal form of oxygen, can now be generated with accurate control by ultraviolet rays from a new mercury-vapor lamp. Demonstrated above by Samuel G. Hibben, research expert of the Westinghouse Lamp Division, the new germ-killer employs a coiled quartz tube. An important application foreseen for it is in making storage eggs stay fresh longer by surrounding them with an atmosphere of ozone, which soaks into the "pores" of the shells. Ozone can also be used as a commercial bleach, to make quick tests of the color-fastness of inks and dyes. It is commonly produced by passing electric sparks through air.

SMUGGLERS' TRICKS are being tried by the Germans in their efforts to get contraband materials past the Allied blockade. The square tins shown below were shipped on a neutral vessel under navicert as bacterial peptone. When opened by suspicious British blockaders, they were found to contain gland extract for treating shock.





MONAZITE SAND, produced by the disintegration of granite rocks, gives us rare-earth metals and thorium. Close-up below shows how the brittle resinous grains vary from honey-yellow to brown. In peacetime, much of it went into mildew-proofing fabrics (middle photo, below) and making "flints" for cigarette lighters. War uses are in electrodes for searchlights, filaments for radios

War Metals from Sand

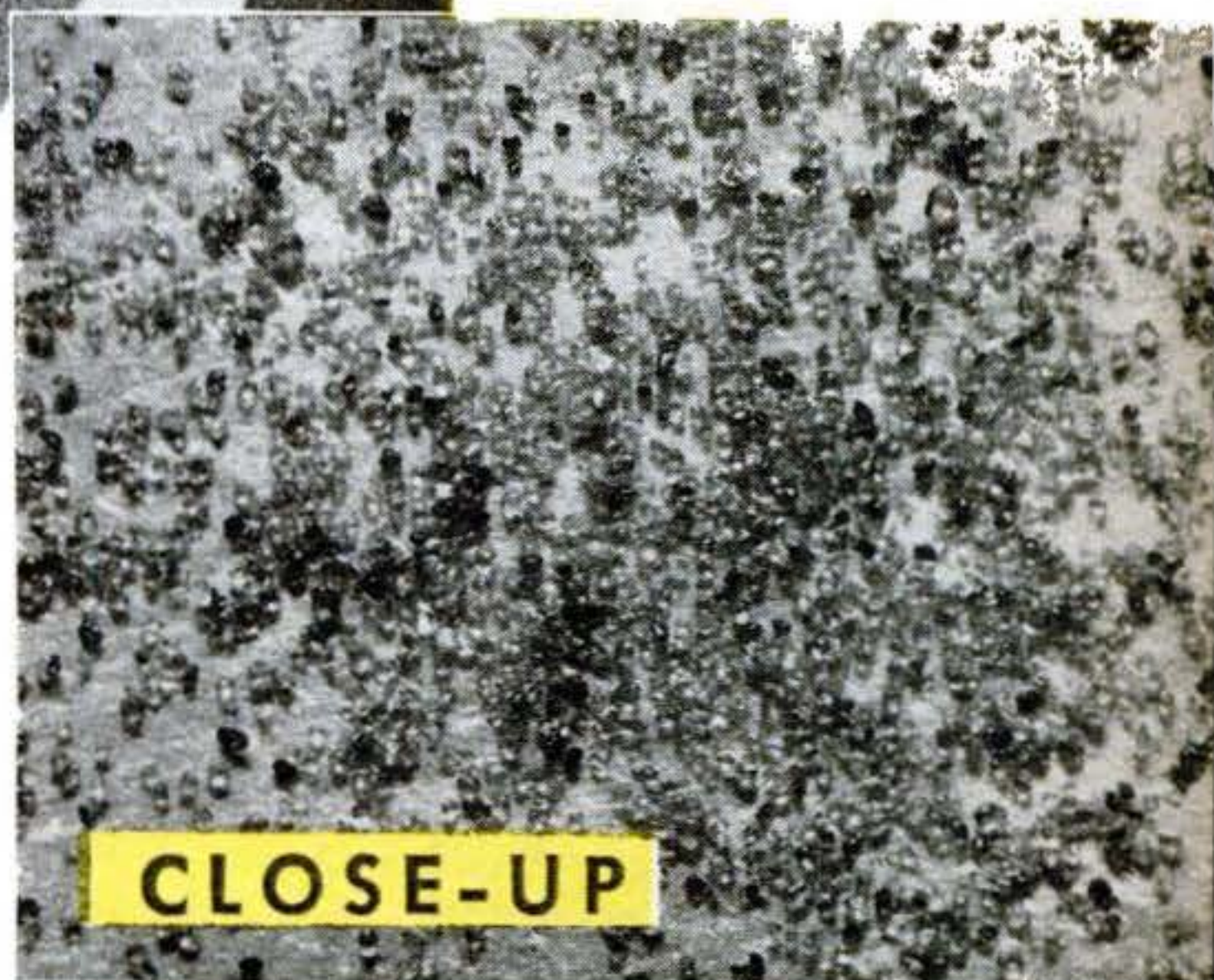
WELDING goggles, searchlights, incandescent lamps, radio tubes—these are only a few of the wartime necessities that are improved by the use of little-known elements found in monazite sand. Produced in dune and beach deposits by the weathering of granite rocks, this sand was once used chiefly in making Welsbach mantles for gas lighting; now it is vital as the only commercial source of the "rare-earth" metals and of the metal thorium.

Cerium, most abundant of the rare-earth metals, is mixed with carbon to make cores of arc-light electrodes for searchlights, film projectors, and therapeutic lamps. In England, it is alloyed with aluminum to produce a strong, lightweight metal for airplane castings. Cerium acetate makes textiles mildewproof. Other salts have medicinal uses. Salts of lanthanum and erbium, members of the rare-earth group, go into beauty preparations.

Welding-goggle lenses made with praseodymium and neodymium cut off useless visible rays and harmful ultraviolet rays to protect workers' eyes.

Thorium, also obtained from monazite sand, finds important use in radio tubes. Filaments containing a trace of this metal operate at lower temperatures than filaments of pure tungsten, prolonging the life of the tube. Both thorium and cerium salts are used as catalysts in chemistry.

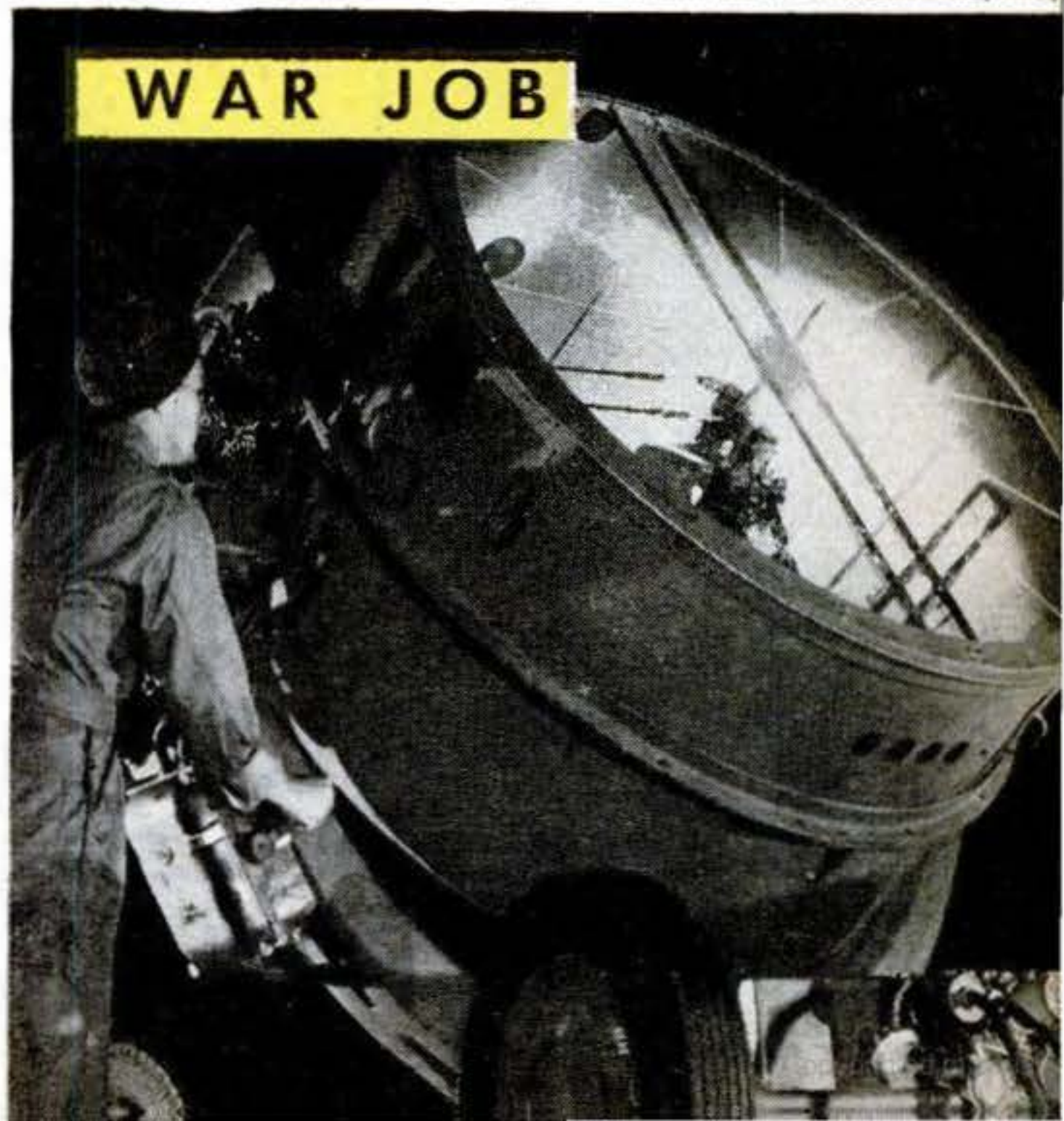
Before the war, 75 percent of our supply of monazite sand came from India. With that source cut off, most of our importation is now from Brazil. If necessary, however, we can get all we need by working deposits in the Carolinas, Florida, and Idaho.



CLOSE-UP



PEACE JOB



WAR JOB

How Binoculars Are Made

Fighters on sea and land need these powerful prism instruments. . . . Here's the story of the mass-production methods that supply far-seeing eyes for warriors.

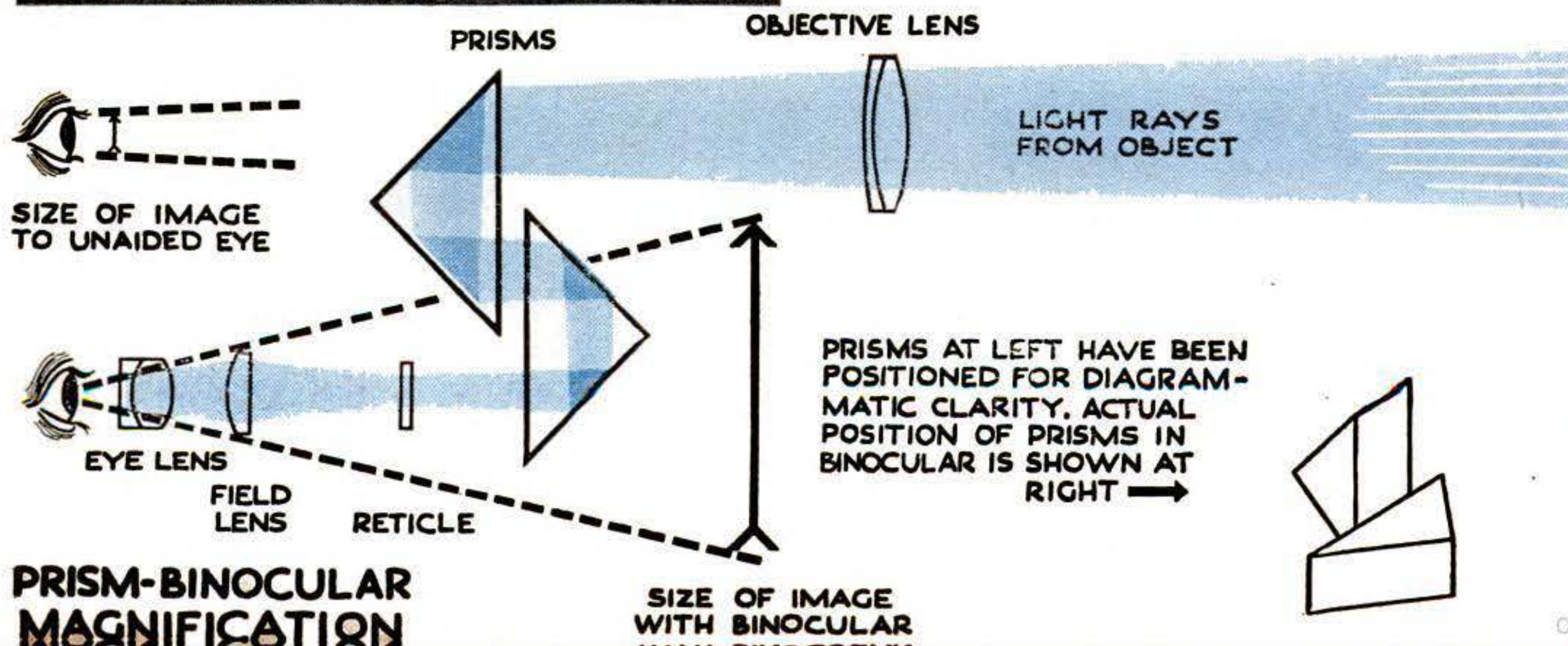
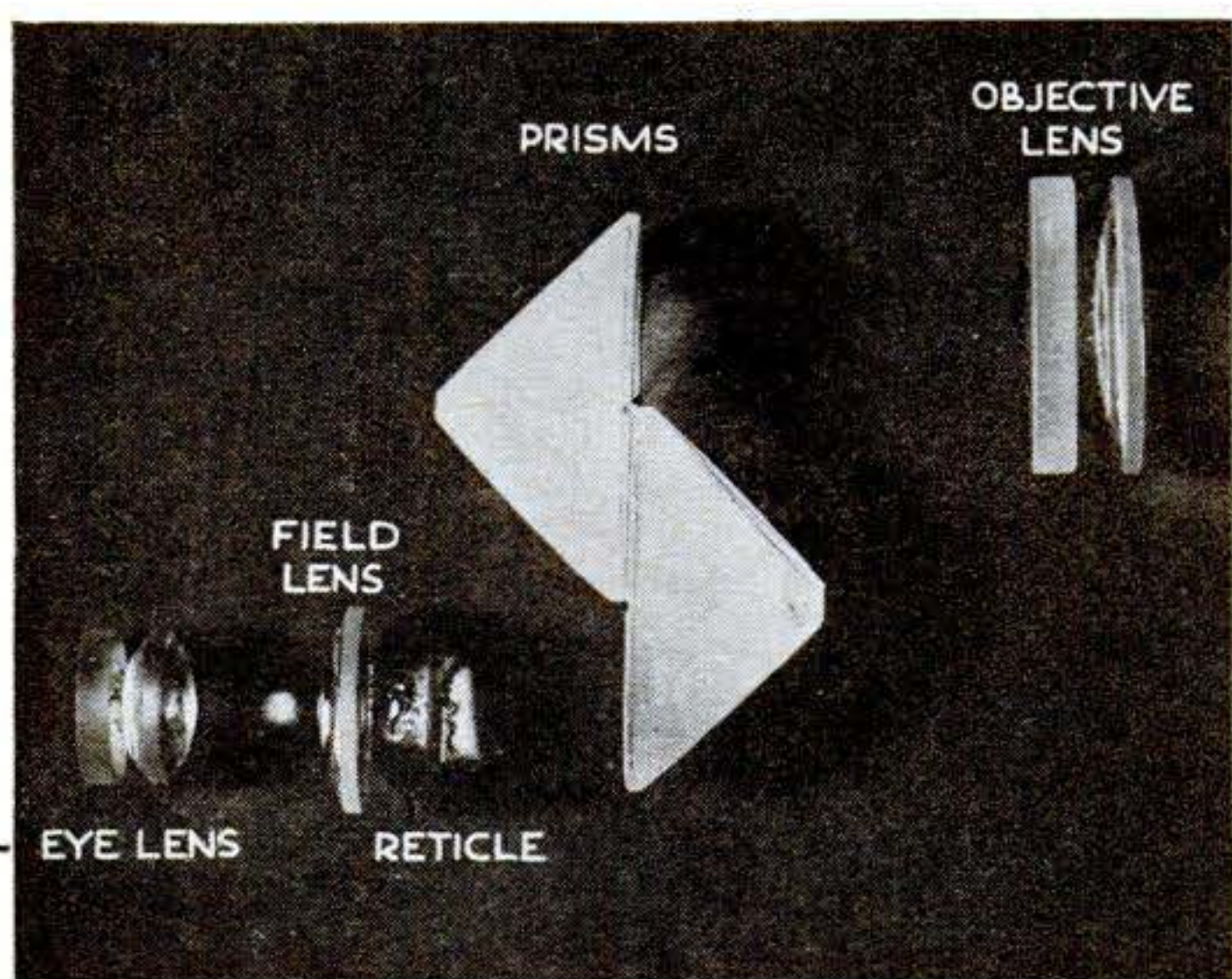
Photographs taken by **ROBERT F. SMITH**
at **Universal Camera Corp., New York, N. Y.**

AMERICA'S front-line fighters must see more than meets the eye. In every battle zone—land, sea, and air—they're called upon to perform ocular miracles. It's their job to unmask camouflage, dissect heat and haze, and scan hopeless dis-

tances to get information that spells victory. They must spot the enemy before he sees them. And they're doing it with American-made prism binoculars, now in mass production for the first time.

The ingenuity that made this possible has been rewarded with an "E" presented by the Army and Navy to the Universal Camera Corporation of New York. On the verge of ruin in 1940, when war blacked out its European film markets, this firm rallied to take a top place among war industries. Before the end of 1943, its production hit 11,000 binoculars a month for our armed services. That means turning out 150,000 optics (lenses and prisms), to say nothing of fabricating and assembling more than a million metal parts.

Universal has tossed out all the old, traditional methods of making binoculars. Other-





GRINDING THE LENSES

Grinding the objective lenses of prism binoculars is done mechanically with wax-surfaced wheels while a solution of red oxide of iron flows over the work (above right). Batteries of these machines, whose grinding wheels are automatically controlled as to



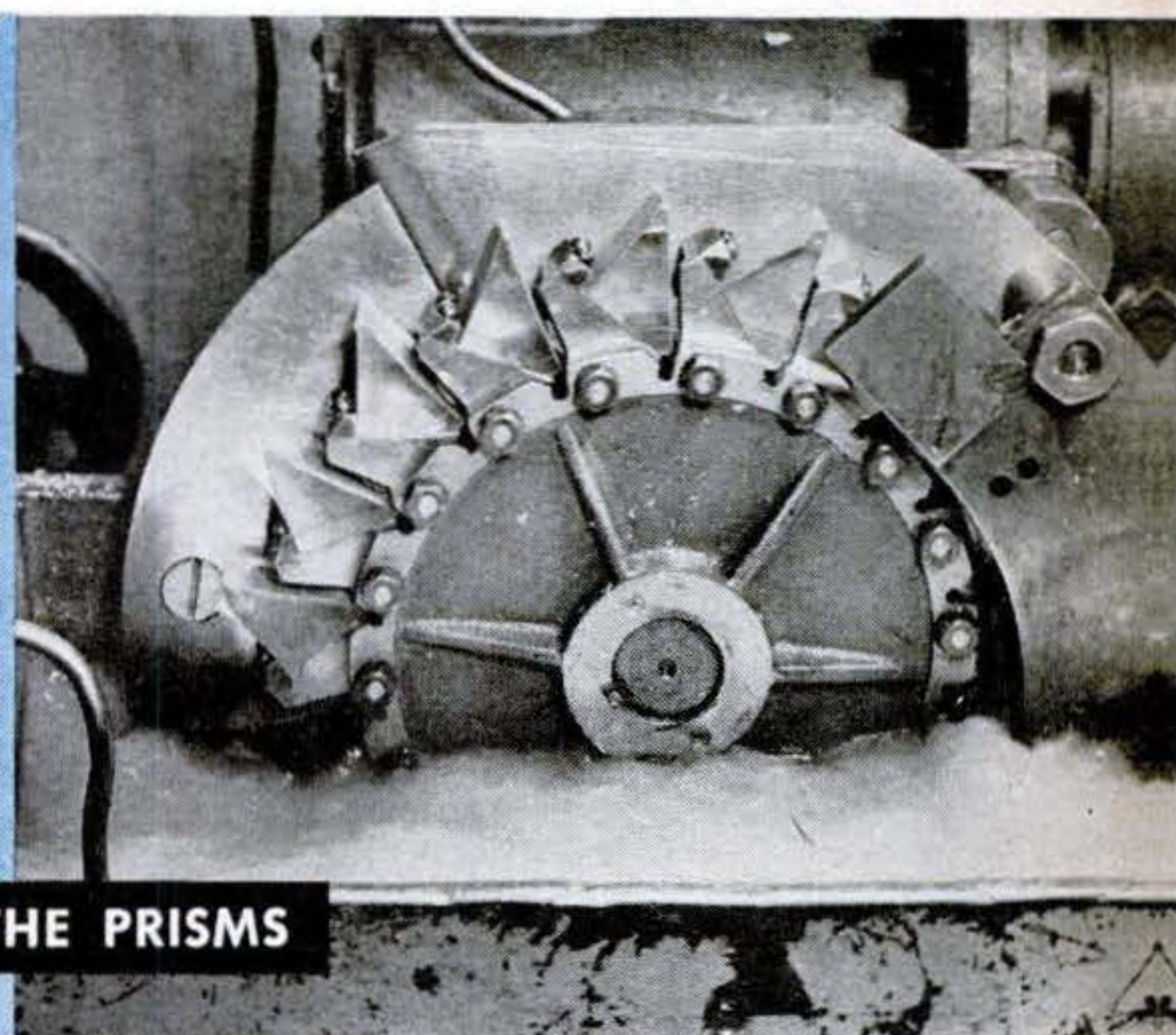
speed and pressure, now mass-produce lenses formerly turned out laboriously by skilled craftsmen. So precise are the machines that they can smooth down a lens to a tolerance of $1/100,000$ of an inch. During milling and polishing, lenses get 116 inspections



MAKING THE PRISMS

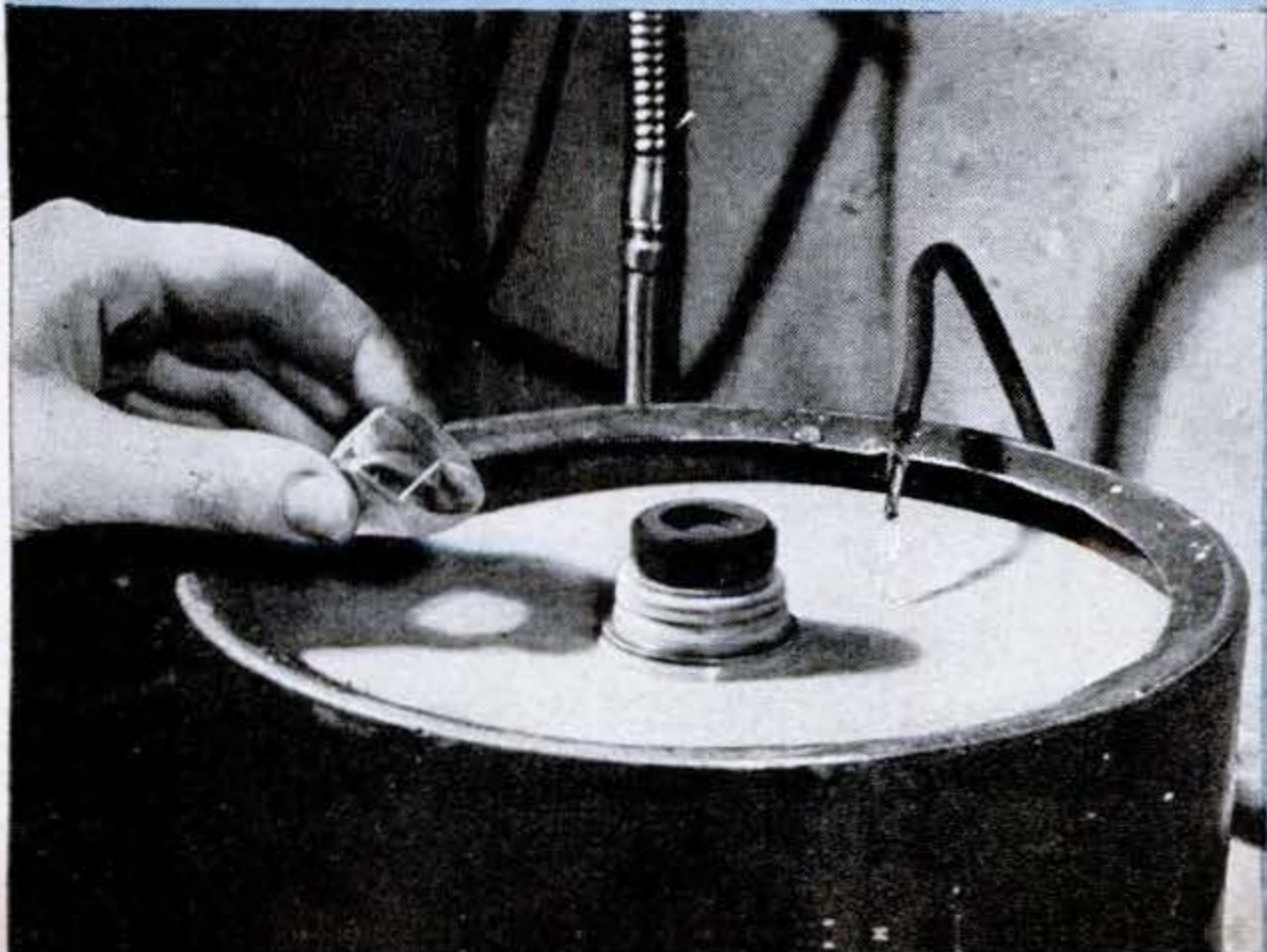
Here a group of prism blanks, made of light barium crown glass, are being placed in a diamond cutting machine. Precisely machined metal blocks are used as holders for the prisms, which are set into recesses and held fast with wax and binding strips

With the faces and sides of the prism now carefully polished, the next step is to bevel all its edges. This is a hand operation in which the prism is held against a grinding wheel, while a stream of ordinary water is played over the stone as a grinding fluid



After being rough-cut, the prism blanks are set in the niches of a milling machine that revolves in a bath of grinding fluid. As the machine turns, it brings one side of each prism into contact with a polishing disk, which is beneath fluid's surface

A clamp that will hold it firmly in the binocular is about to be placed on a prism. At this point, the prisms have been paired off so that one having a plus deviation in the verticality of transmitted light is coupled with one of equal minus deviation





The housing for a binocular is cast from scrap aluminum, machined, then covered with strips of Vinylite, which has the texture of leather. A soldering iron fuses strips into one piece



A set of prisms is here being placed in one barrel of the binocular. Note that the other barrel is covered to prevent accumulation of dust, which must be guarded against at every stage of assembly

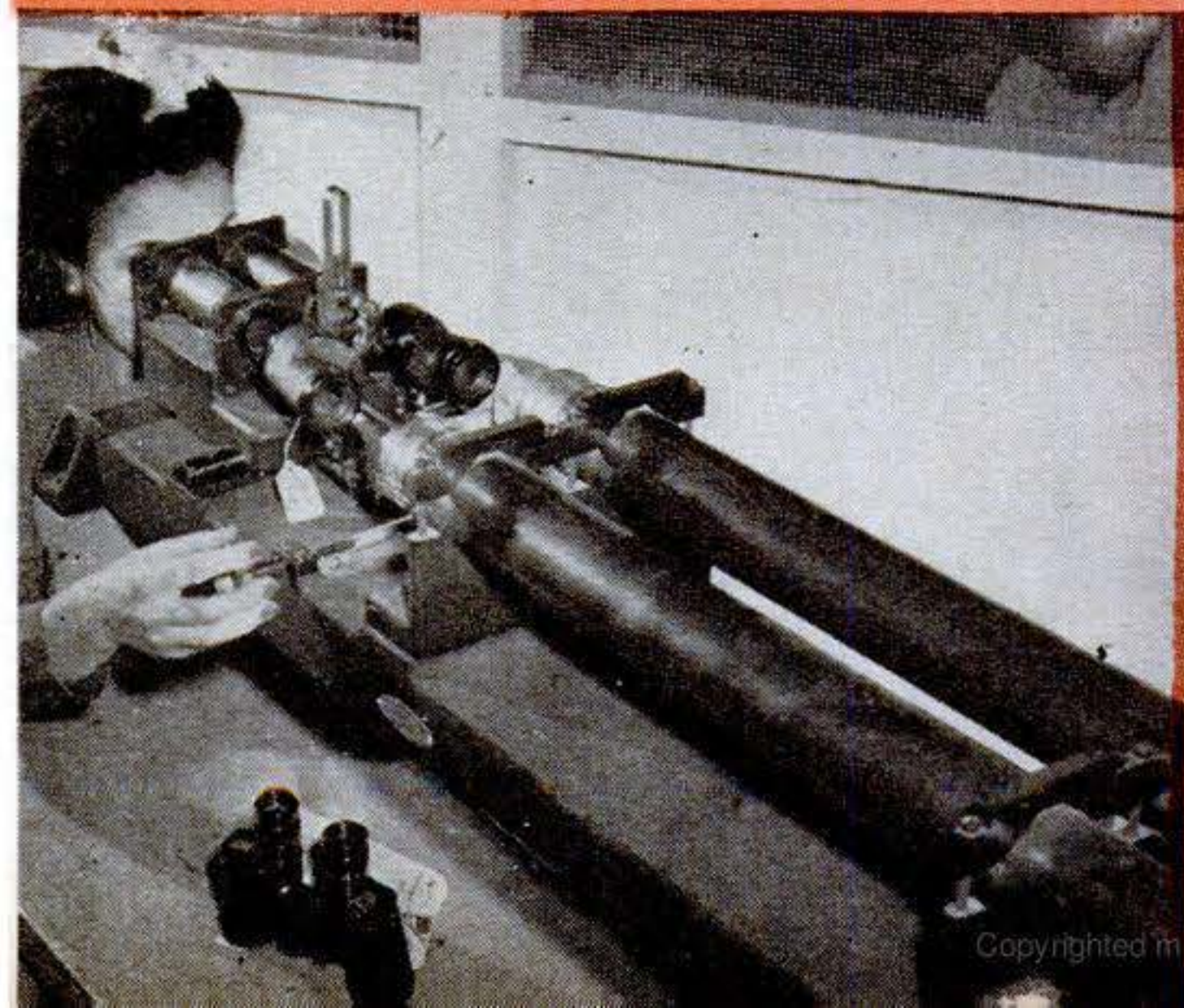
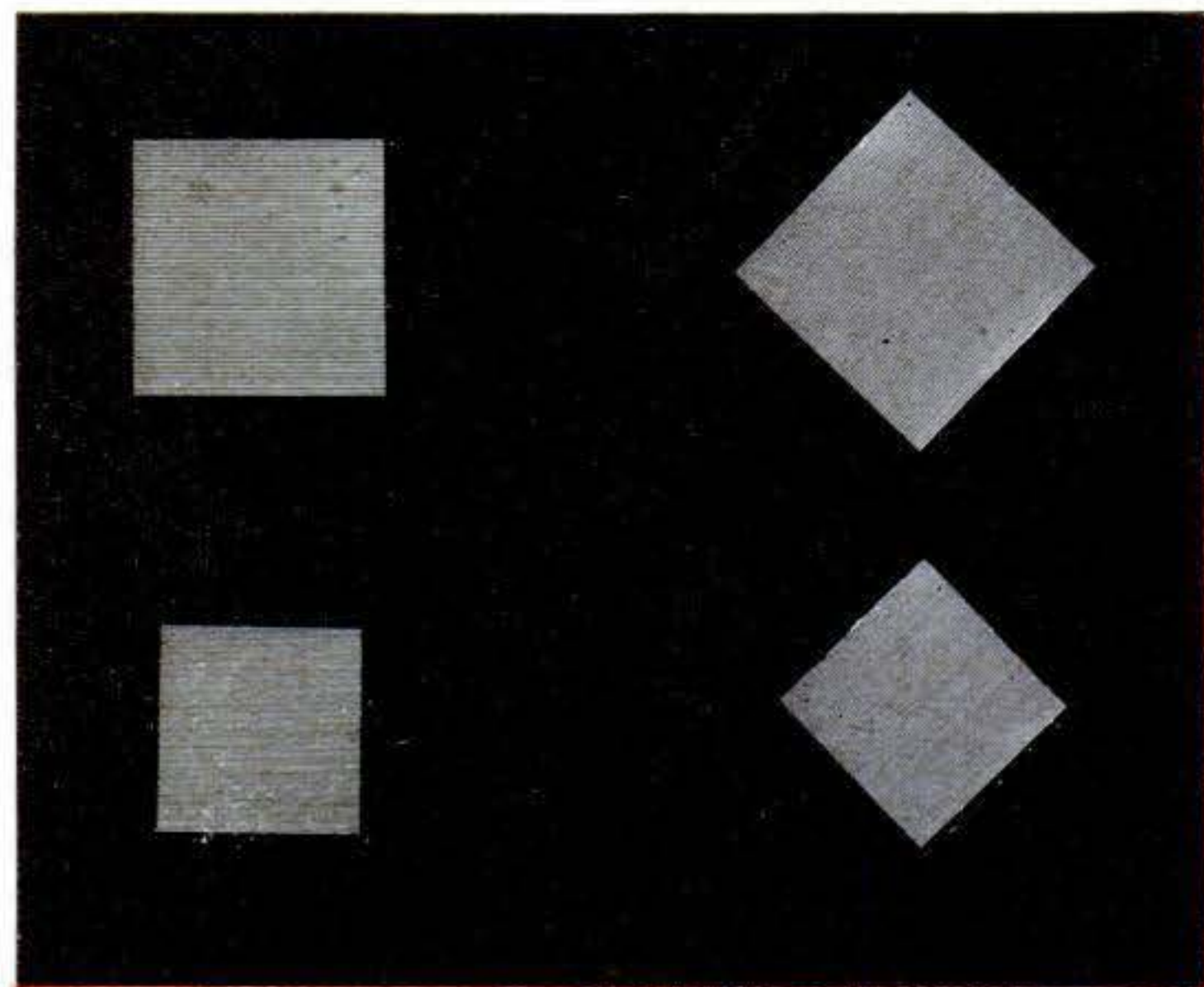
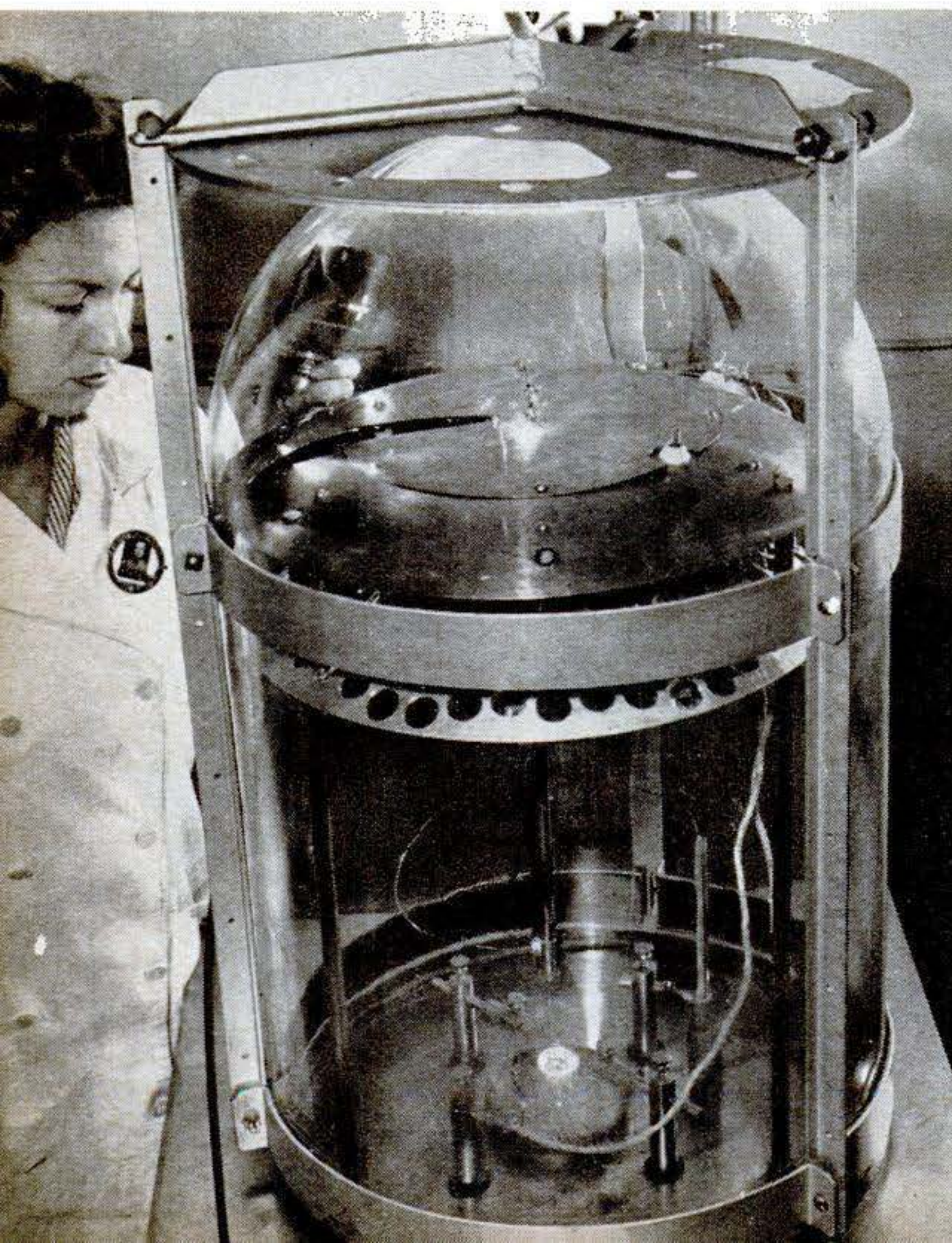
wise, it still might be slogging along neck-deep in red ink. It has turned a highly specialized art into a task for machines tended by unskilled labor. It has speeded the whole cycle of production to a degree undreamed of heretofore.

In preparing flawless faces of lenses or prisms, the basic steps are roughing, grinding, and polishing. The custom is to rough out each glass blank separately, then mount

them in a mold. After that, for the grinding and polishing operations, the mold is spun against abrasives. When one side is ground, it is turned over and ground on the other side. This procedure goes on through all stages of grinding and polishing. It's tedious and time-consuming.

At Universal's plant, sparks fly by application of a three-in-one process. Blanks are mounted on a mold that carries them

To reduce loss of light caused by surface reflection, optical elements in binoculars are being coated experimentally with magnesium-fluoride vapor. Tests indicate coated pieces transmit about 99 percent of light





Objective lenses, consisting of two lenses cemented together and fitted into metal rings, are immediately screwed into place after a suction tube (bottom) removes dust



Assembly of the binocular is completed with the mounting of the eyepiece. This part comprises the field, or collective, lens, a short barrel, and two lenses cemented together to form the eye lens

through roughing, grinding, and polishing as one continuous operation for each side. What's more, molds are so designed that unskilled hands can easily insert blanks. This simplifies the formerly complicated task of mounting. For the final polishing—a job that once required fine judgment and skilled hands—Universal automatically applies a liquefied oxide that not only does just as well, but also minimizes chances of

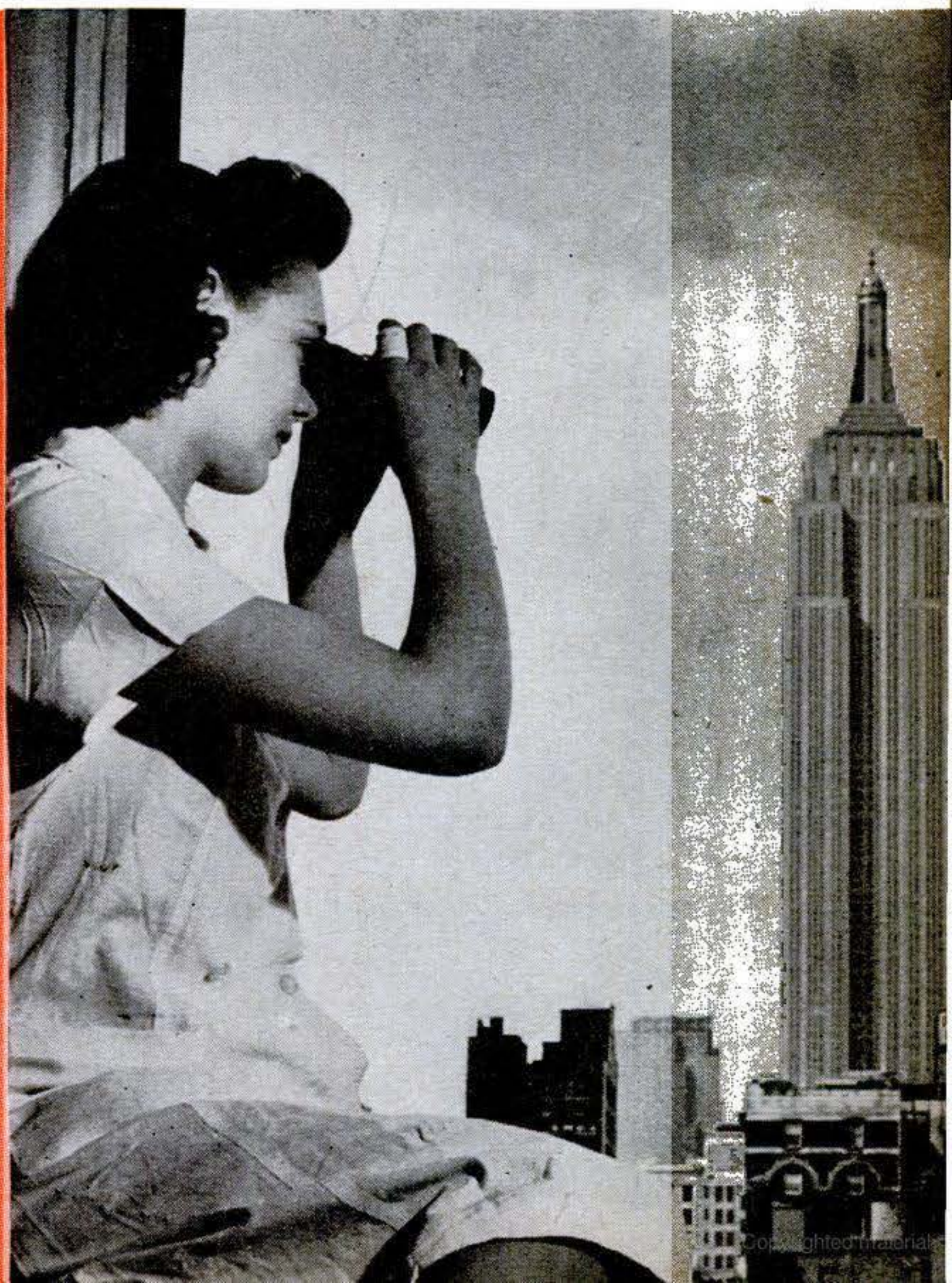
human error. In all, this new method of making binoculars has established a manufacturing precedent that will endure long after the war is over.

For the present, however, its task is to speed the flow of urgently needed binoculars to our fighters on land and sea. With the aid of these precision-built instruments, Americans in all services will be able to see better and fight better.



INSPECTION

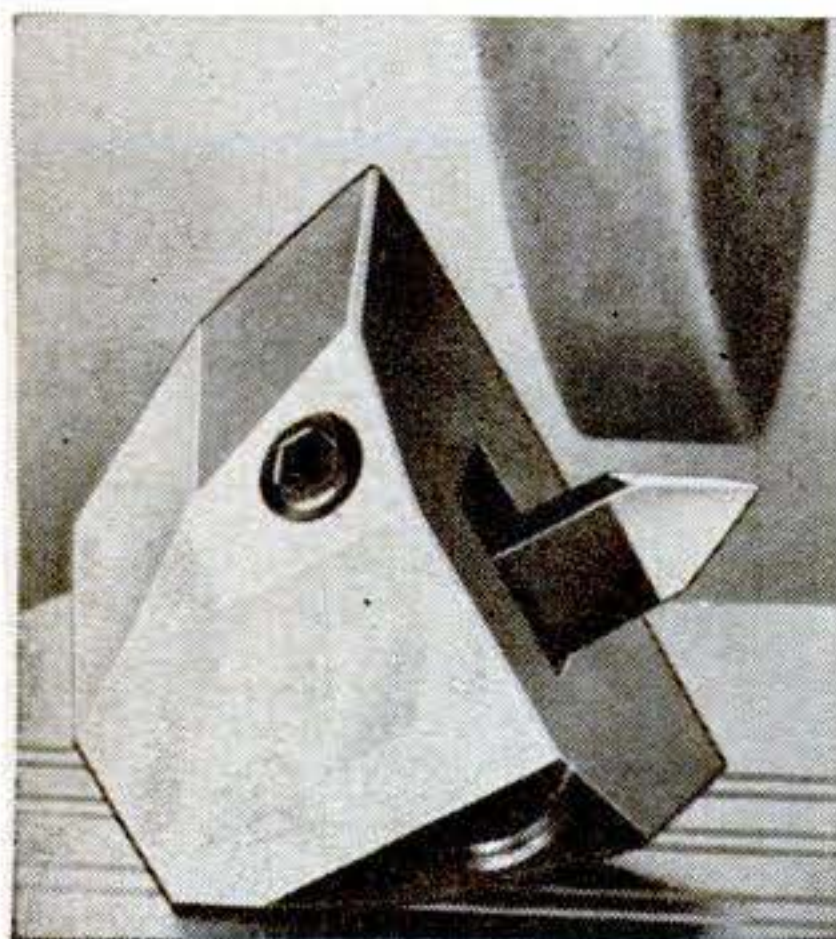
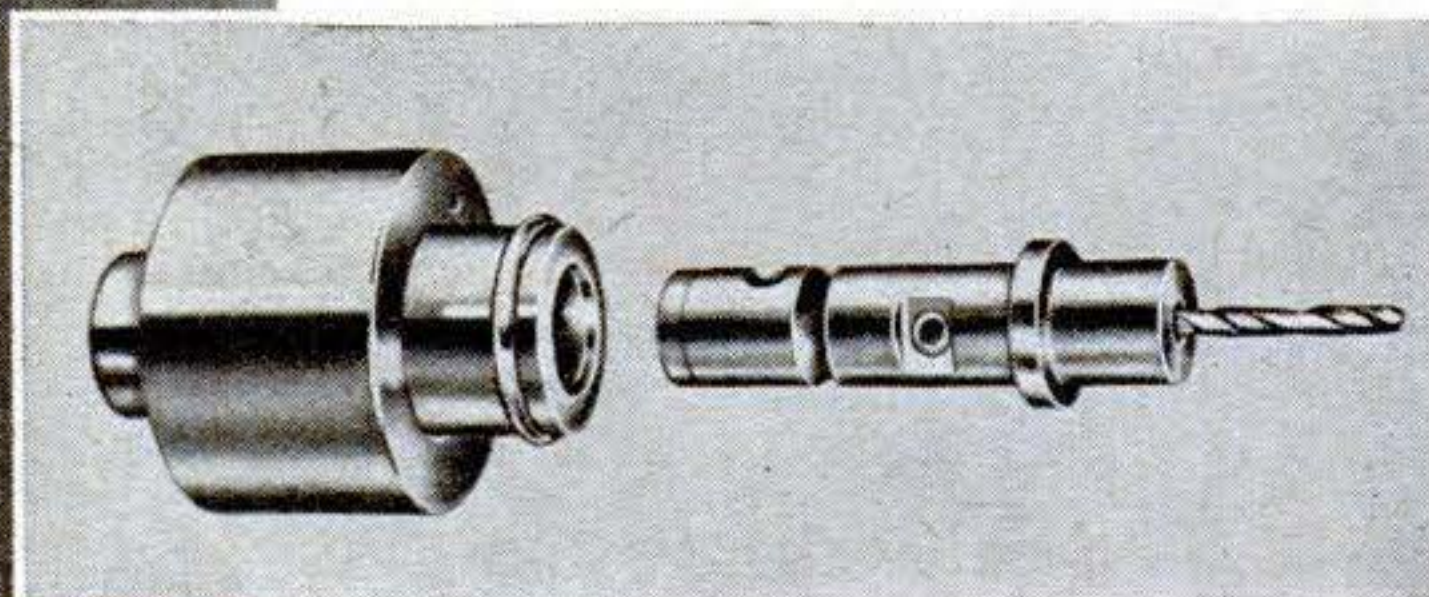
An illuminated screen containing squares on which fine lines are drawn is used to test the ability of the binocular shown above to distinguish two parallel lines when they subtend five seconds of arc at the instrument. At the left, a military binocular is checked to see if its two ocular axes are parallel. The girl above is using an auxiliary scope, an ordinary telescope placed over one of the eyepieces of a binocular to magnify its normal resolution. A binocular is also sighted on an actual object to test clearness, color dispersion, and astigmatism. And, finally, it is placed in a tank of water to see how waterproof it is, and then dropped six feet into a sand pit to test its ability to withstand rough handling





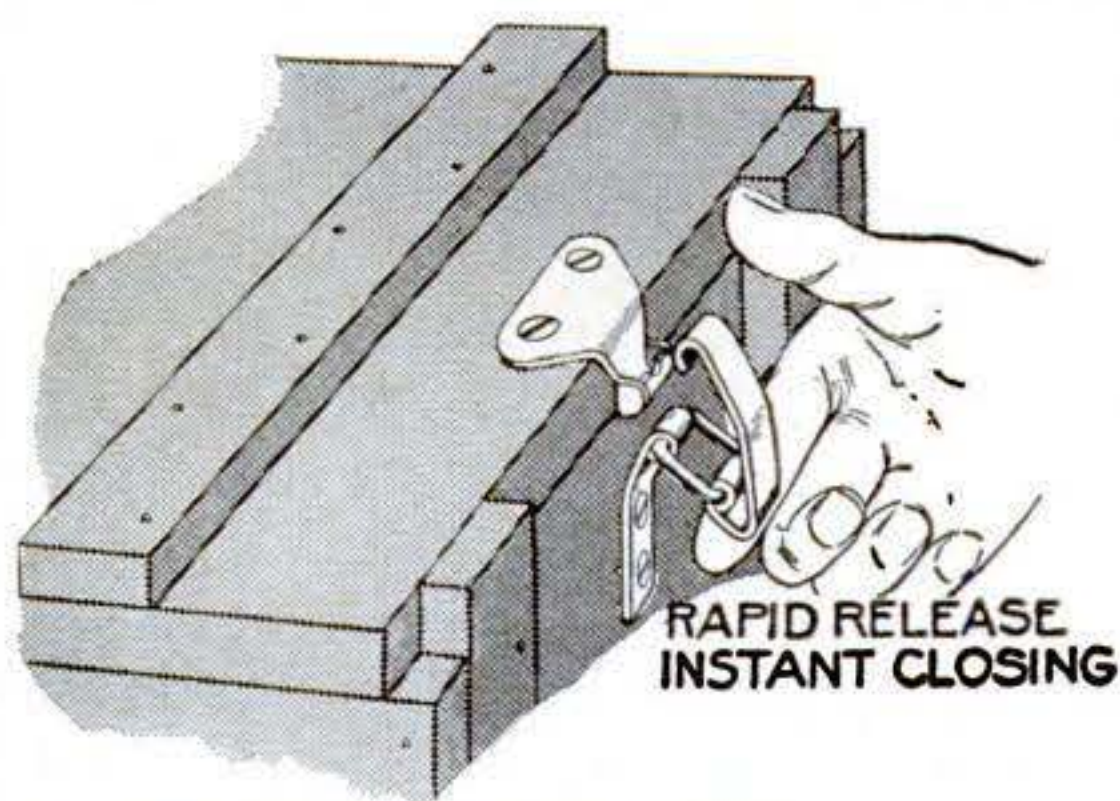
new Tools

DRILL TOOLS can be changed in three seconds in this chuck while the motor is running, by sliding back a sleeve to release the tool and adapter (see below), then moving the sleeve forward to lock the new tool centrifugally. Made by R. M. Wright Co., Royal Oak, Mich.

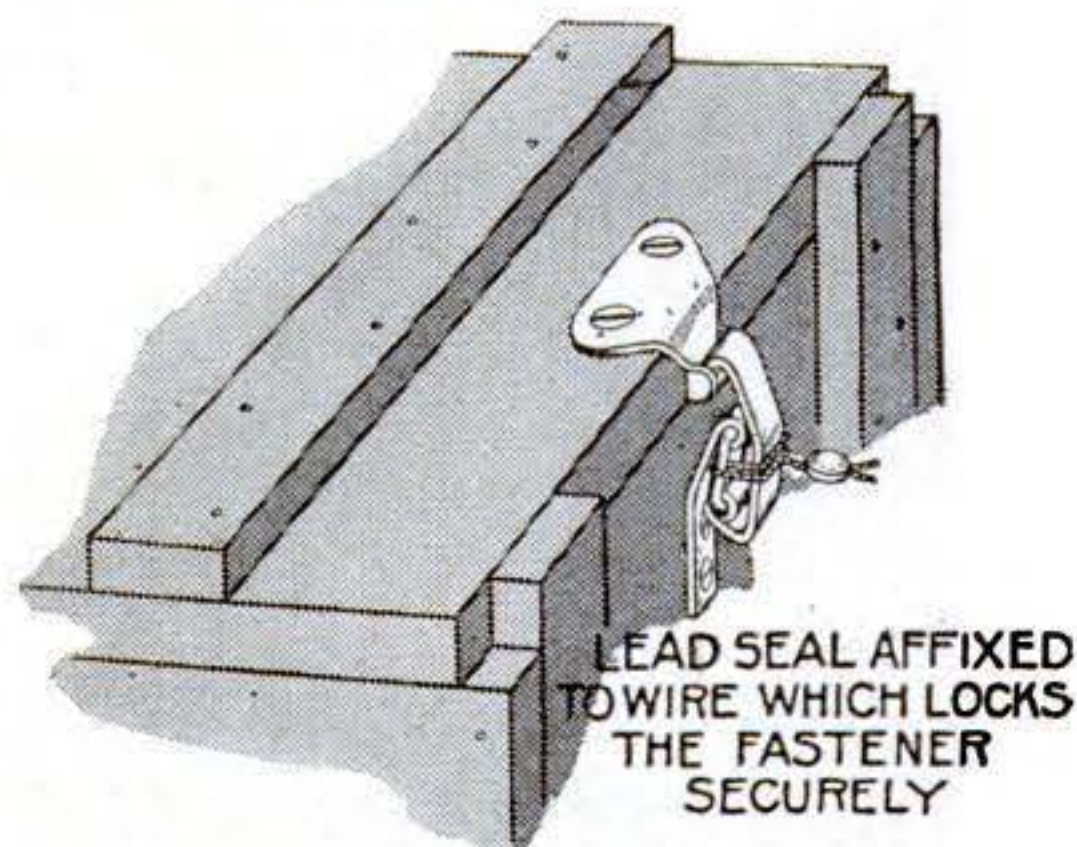


GRINDING both 60-degree and 29-degree threading-tool bits can be done accurately and quickly with the aid of a many-sided fixture brought out by Robert H. Clark Co., of Los Angeles. The bit is held by a setscrew in the fixture, which is properly positioned for the thread angle

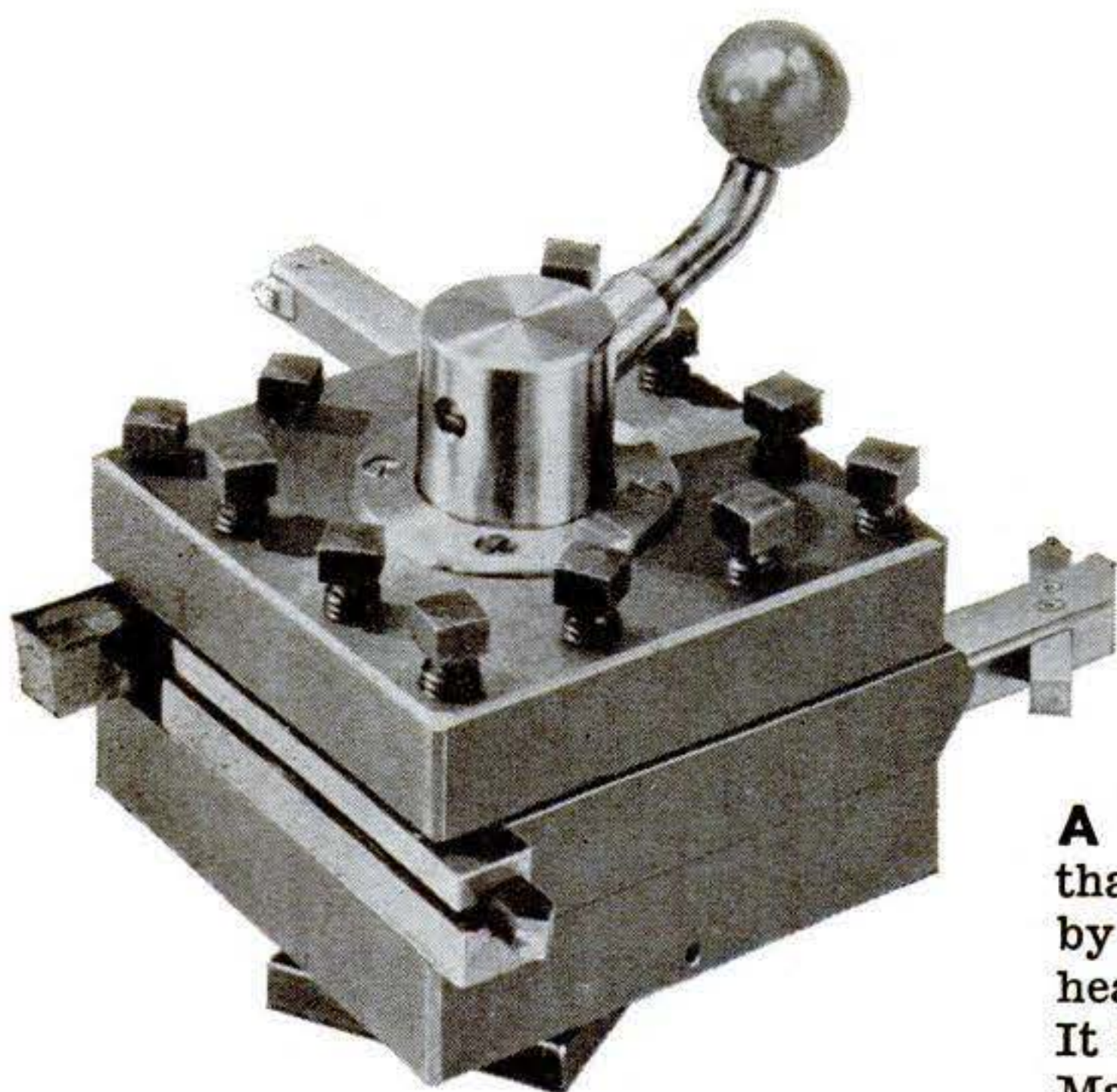
desired, as indicated on the fixture. The design of the fixture permits it to be clamped to a table or held by a magnetic chuck, as shown.

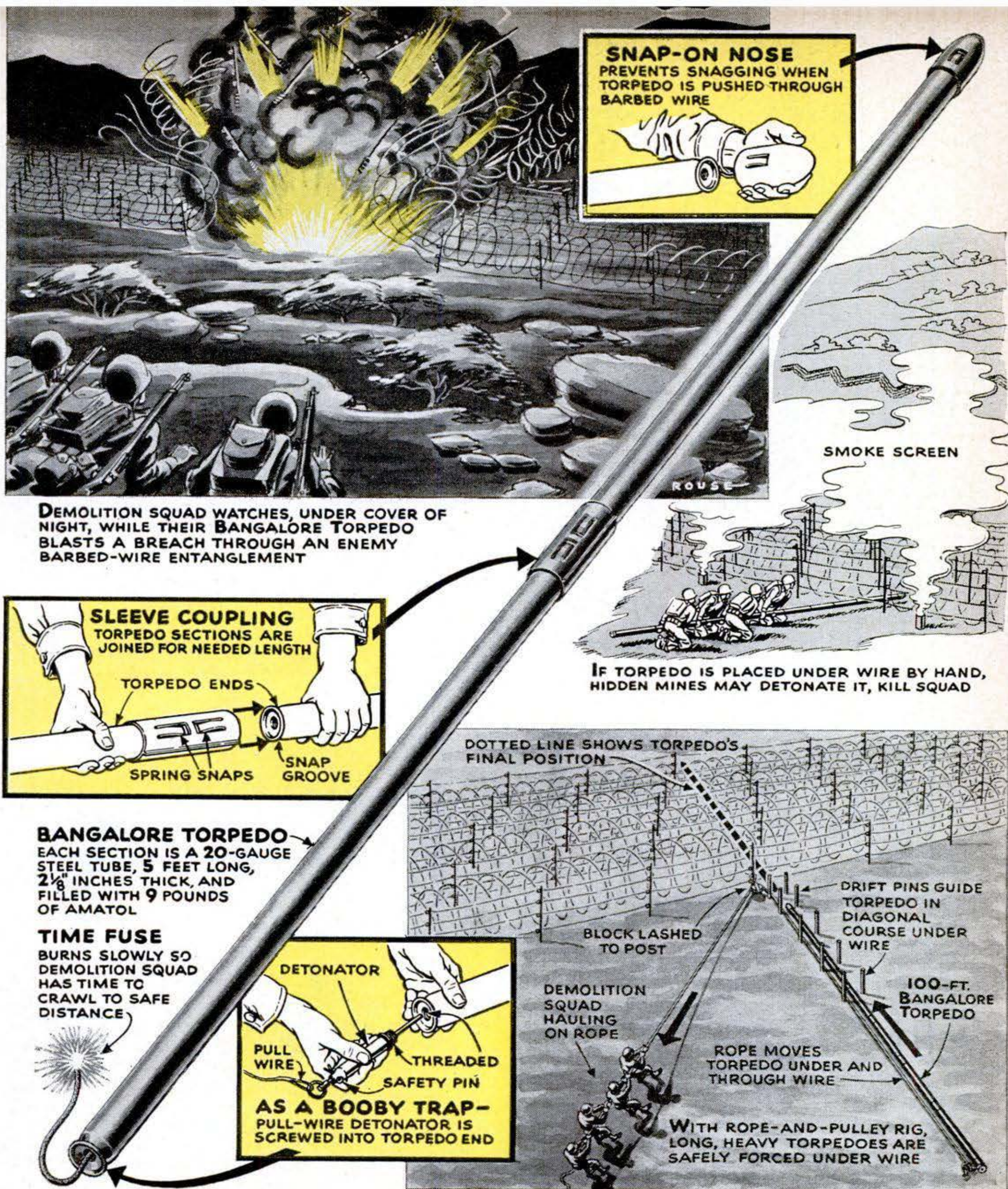


TOGGLE-TYPE LOCKS that save metal and need only four screws each for installation have been developed by the Maximlok Co., of New York, for use on Army ammunition boxes.



A TOOL-POST TURRET carrying four cutters that can be presented to the work in turn by turning a handle has been designed for both heavy roughing cuts and precision lathe work. It has automatic indexing, and is made by the Mark Naught Co., Portland, Ore.

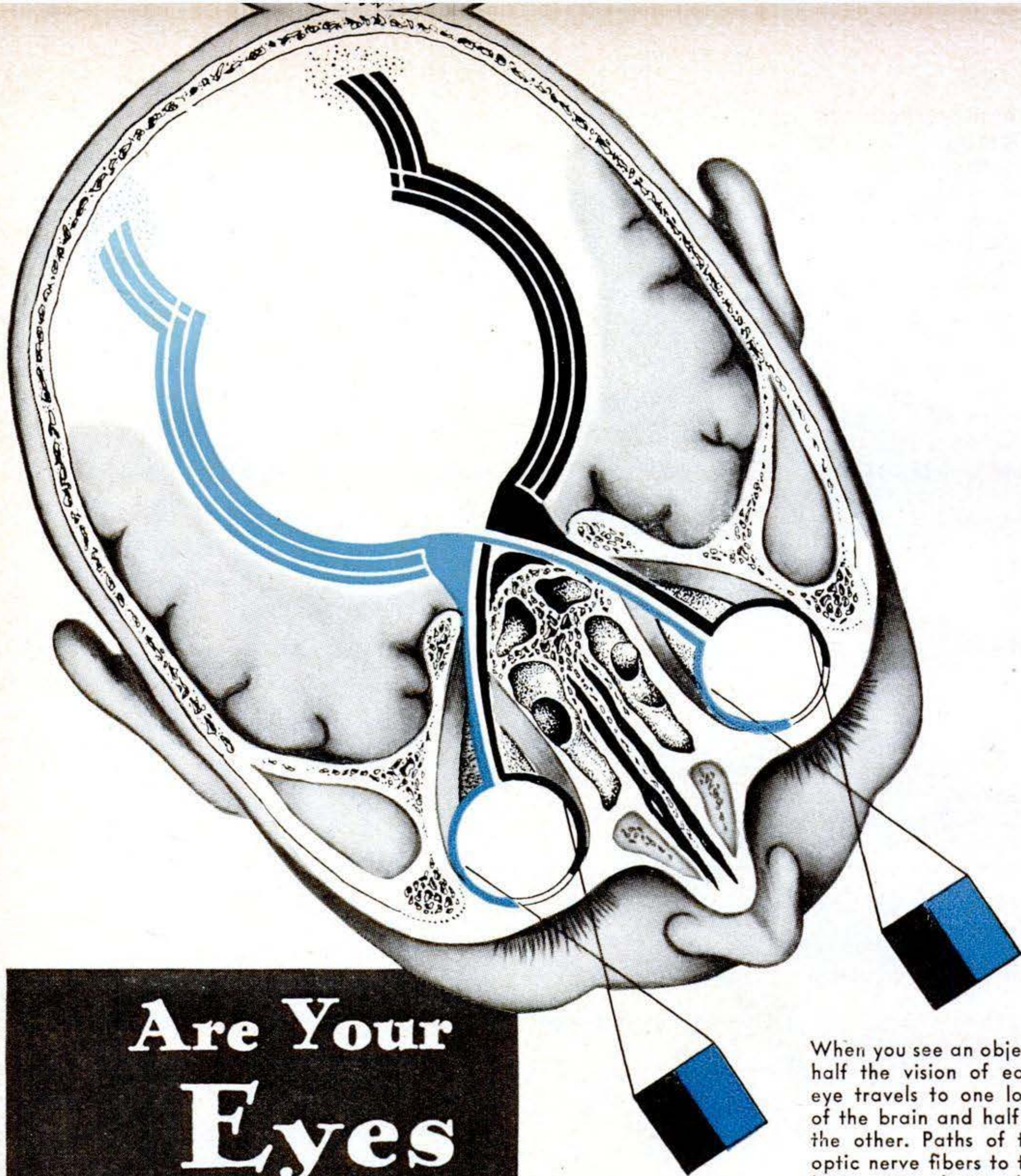




Pulleys Place Giant Bangalores

JOINTS of explosive-filled metal tubing, sleeve-coupled to lengths of 100 feet or more, slither under the enemy's barbed-wire entanglements to blast a breach for our assault troops. Fragments of metal cut the wire like knives and sweep a path 20 feet wide. Far more effective than the original bangalore torpedo (P.S.M., June '42, p. 49), the current version is placed by an ingenious snatch-block arrangement. A scout creeps to the obstacle, attaches the

block to a post or picket, and runs a rope through it. One end is secured to the butt of the torpedo, the other in the hands of the demolition squad stationed at a safe distance. Guided by drift pins, the torpedo slides under the wire. Its round-capped nose prevents snagging. Short lengths make deadly booby traps when the time fuse is replaced by a nonelectric detonator and trip wire. It's also effective in exploding treacherous land mines that might impede advance.



Are Your Eyes Right?

**TODAY, MORE THAN
EVER BEFORE, YOU
SHOULD GUARD YOUR
PRICELESS VISION**

Drawings by JOHN GILMORE

When you see an object, half the vision of each eye travels to one lobe of the brain and half to the other. Paths of the optic nerve fibers to the brain are shown diagrammatically above

MOST of us, unfortunately, take our eyesight for granted. Yet in wartime poor vision is more than ever a calamity. It not only can dull our minds, contort our faces, shatter our nerves, and even lead to total blindness; it also cheats our country of our best services. From the standpoint of patriotism alone, we should know our eyes better.

The extent of our laxity is shocking. A recent survey conducted by the Better Vision Institute revealed that no less than 7,000,000 Americans in war plants are guilty of neglecting faulty eyesight. It found that, despite the almost universal exclamation, "Oh, my eyes are O.K.," seven out of every 10 war workers have defective vision and only three have done anything about it.

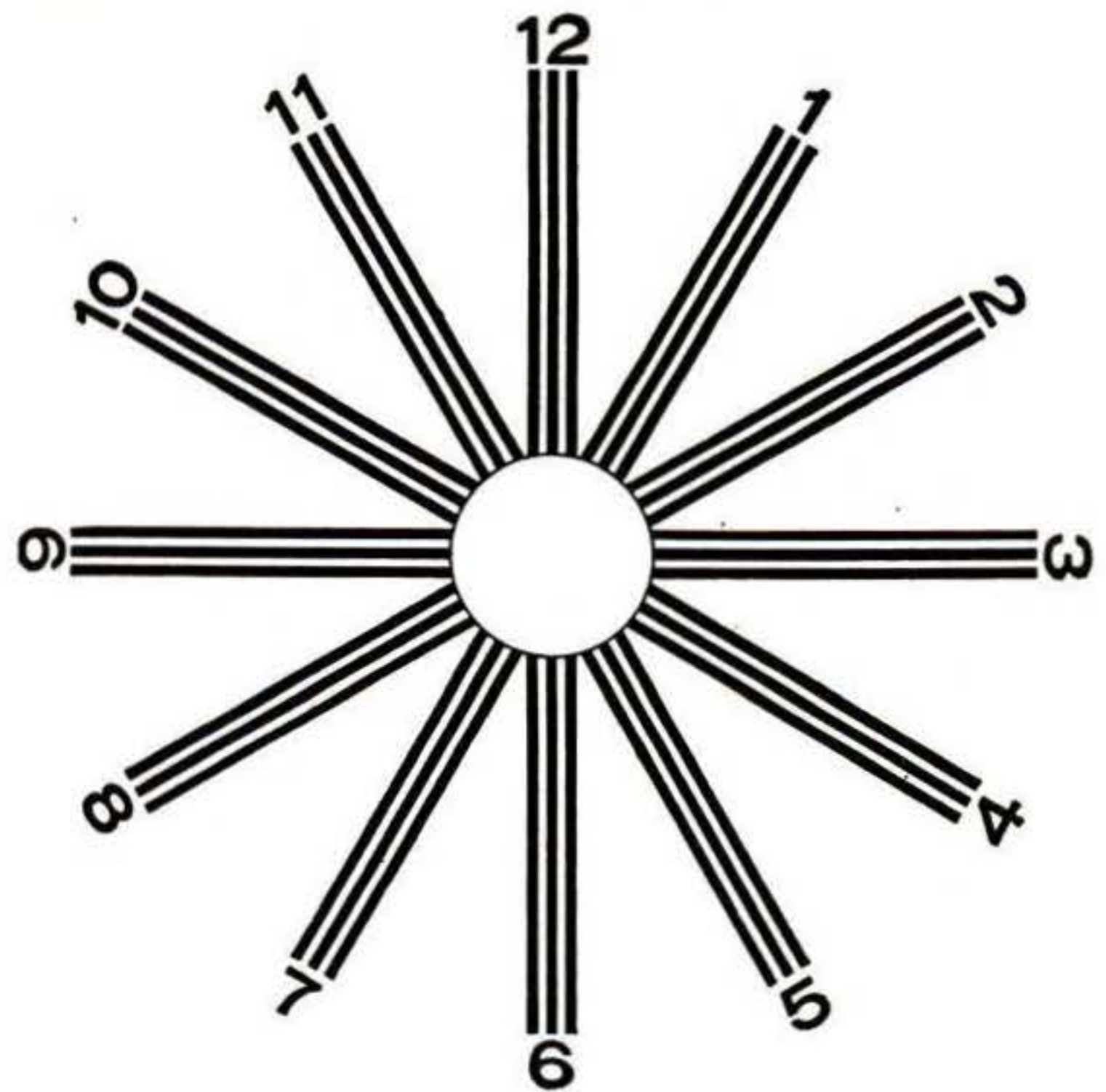
Easy Test for Astigmatism

These workers, with their weak, blurring, flickering eyes, are wasting time, ruining precious materials, and causing accidents. They are, as the Institute puts it, "housing a saboteur."

So important is good eyesight in the Army that mobile optical units are assigned to all field forces. Soldiers with defective vision are examined at regular intervals and given corrections. But only 15 percent of the war plants investigated by eye specialists provided periodic eye examinations; only two out of 10 plants recorded eye conditions of workers involved in accidents, and three fourths of the plants had no means of selecting visual qualities necessary for special, intricate jobs. These employers are as guilty as the workers in neglecting the eyes. They, too, house potential saboteurs.

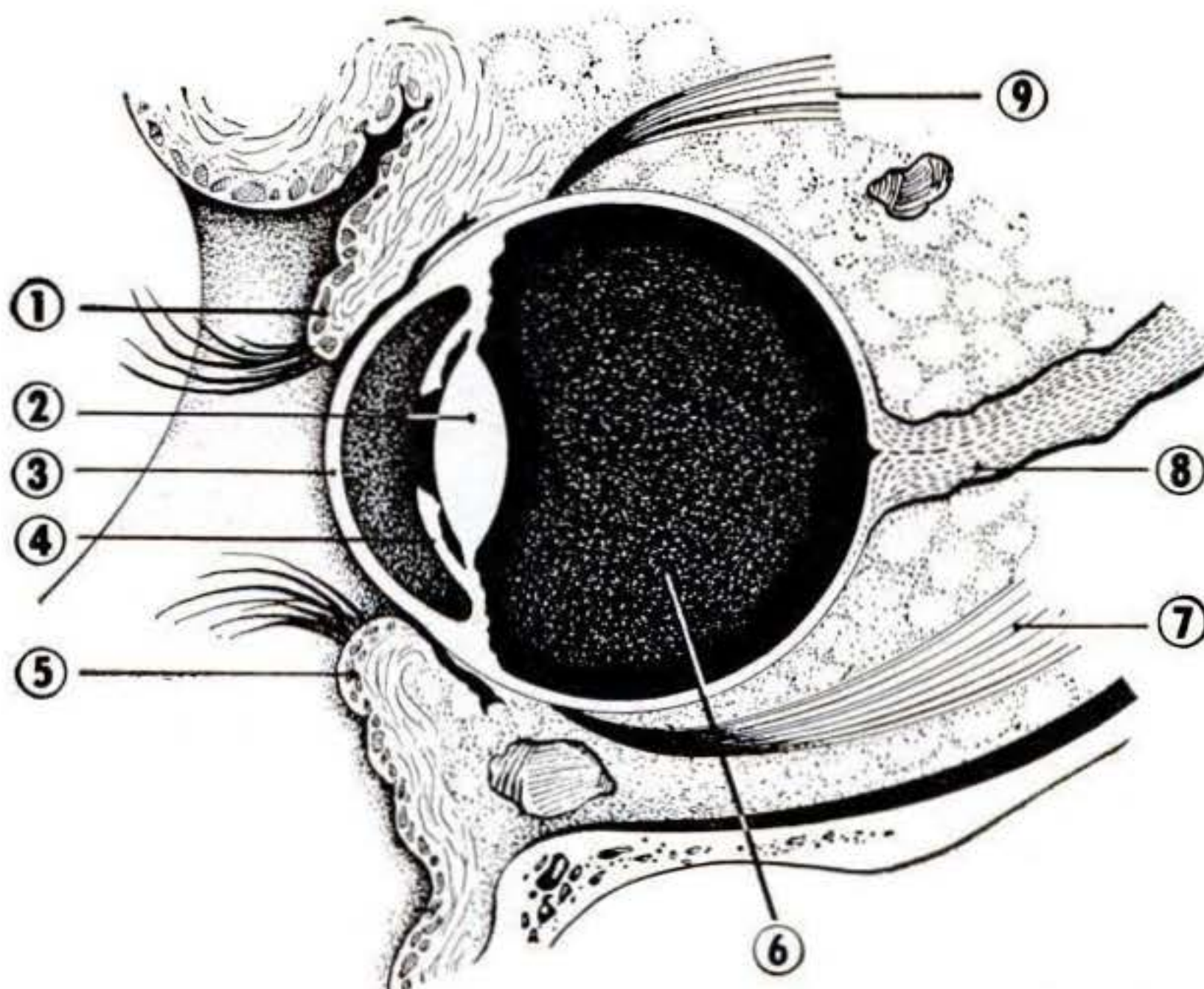
There's no excuse for this dangerous civilian laxity. Eye specialists, in sufficient numbers, are available. They have the proper equipment and knowledge. And the benefits of eye care far exceed the efforts involved; for good vision, with or without the aid of glasses, is one of our greatest physical wonders.

Science has yet to perfect an instrument as ideally suited to conditions imposed upon it as our optical system. The nearest approach is the camera. When the camera



Astigmatism is the inability of the eye to see horizontal and vertical lines with equal clearness. Study the diagram above and note if some of the lines appear to be thicker than others. Now rotate the diagram slowly. Does this tend to make other lines appear to be thicker? If it does, then you have an astigmatism

catches a picture by means of a lens, it projects it to the back of a black-walled box, where it impinges on a sensitized plate that reacts to light, thus fixing the image. To obtain clearly focused and well-illuminated pictures at all times despite changing outside conditions, the lens is equipped with a diaphragm that contracts the lens



A CROSS SECTION OF THE EYE

1. Upper lid
2. Lens
3. Cornea
4. Iris
5. Lower lid
6. Vitreous body of the eye
7. Inferior rectus muscle
8. Optic nerve
9. Superior rectus muscle

aperture as required. The eye, too, possesses a diaphragm which regulates its own lens aperture. Back of the lens is a light-sensitive curtain on which images form. These images are flashed by a unique wiring system of optic nerves to brain centers responsible for vision.

Each eye turns freely in its skull socket, protected by the bony structure and guided by six little muscles working in pairs. For perfect vision, the pairs of muscles must be of equal length and strength, so that in normal position the eyes look straight ahead. The eyeball, which is the eye in its totality, is round except for the window, or cornea, at the front. Through the cornea light rays reflected from objects enter the crystalline lens within the eye and pass to the rear curtain or retina.

By means of an ingenious system of valves, the eyeball is kept "blown up" with ocular fluid. If it is pierced, this transparent colloid flows out and the eye collapses like a punctured tire. But the eye may not be lost; should the opening close, the fluid collects once more and the eyeball again fills.

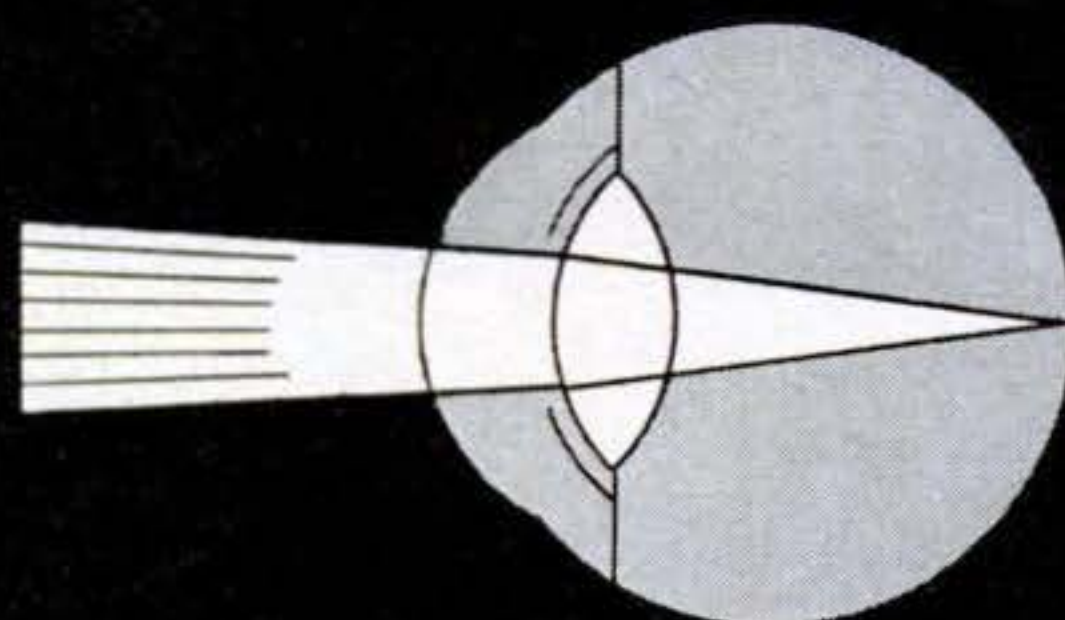
Those fortunate persons whose vision is normal have lenses within the eyes of exact power to focus light rays perfectly at 20 feet. Rays vary from nearly parallel ones that come from a distance to those from near-by objects, which spread as they reach the eye. So, like the camera diaphragm, muscles surrounding the lens must change its surface to project the correct image. This is called accommodation. It is the "open sesame" of good eyesight.

Many defects in eyesight stem from the fact that our eyes must work as a pair. No greater teamwork is required than that of our eyes. They must be in perfect alignment, move in unison, have the same power of accommodation, and the same reactions to light. One of the most prevalent faults in vision results from imperfections in eye muscles. Our eyes turn inward, outward, upward, or one above the other—and efforts to align them cause nervousness and fatigue. But this defect, and at least four other common deficiencies, generally can be corrected by exercises or use of eyeglasses.

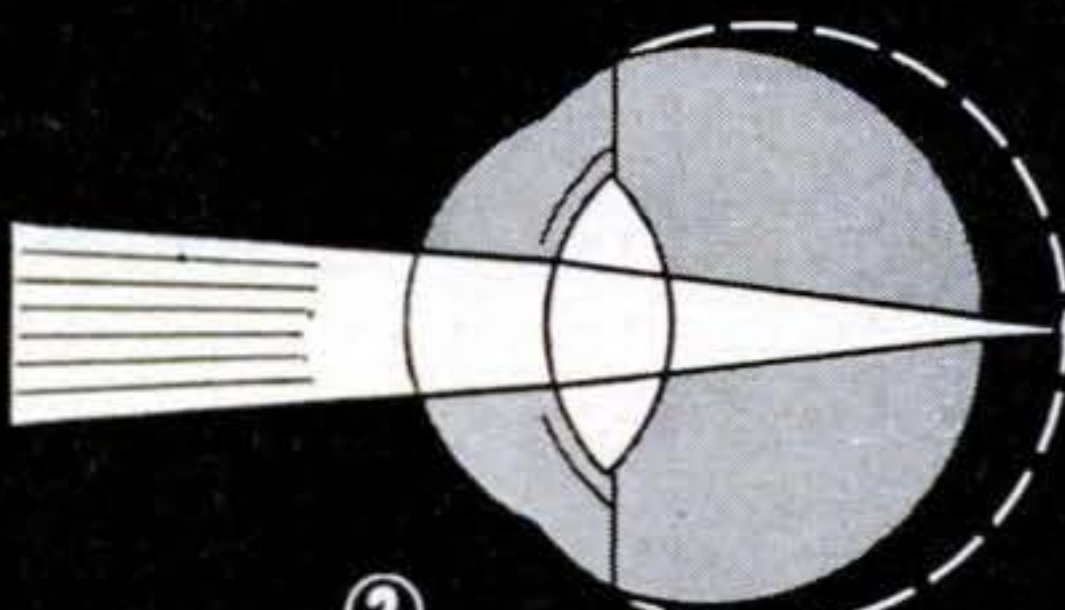
Failure to heed the first indication of failing vision is both foolish and unpatriotic. No good can come of it. It is our duty not only to keep our eyes open, but to make sure they see well.

In normal vision (1), light rays entering the eye come to a focal point right at the retina. If the eyeball is too short (2), the rays focus at a point in back of the retina, causing farsightedness. This defect is corrected with convex lenses (3). If the eyeball, however, is too long (4), the focal point is in front of the retina, and the result is nearsightedness. Concave lenses (5) are then required

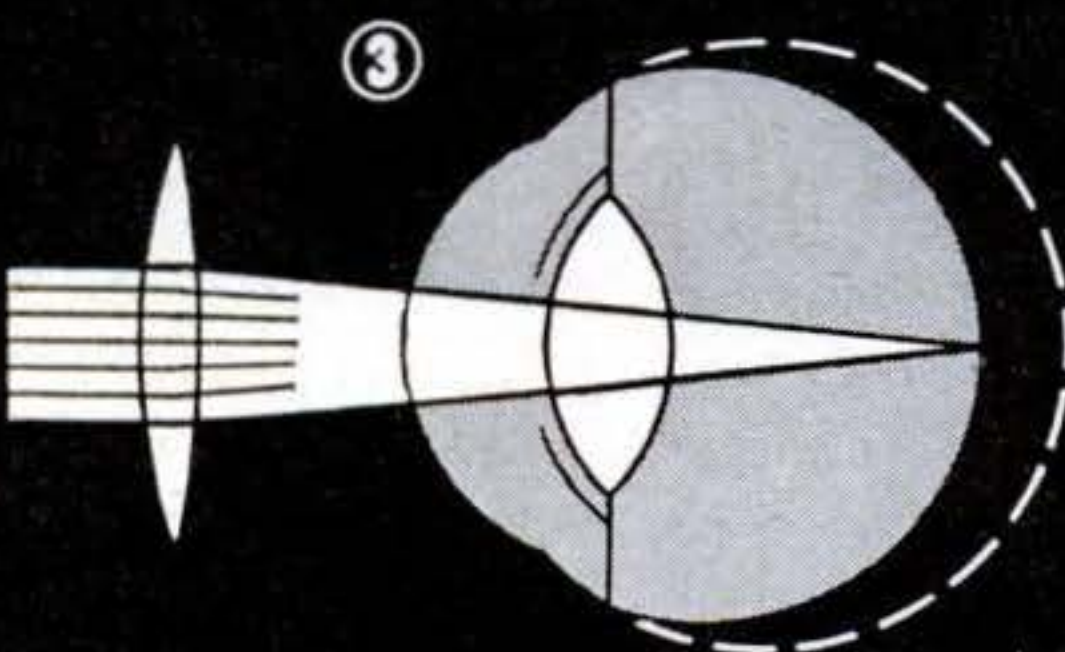
HOW GLASSES HELP YOU TO FOCUS CORRECTLY



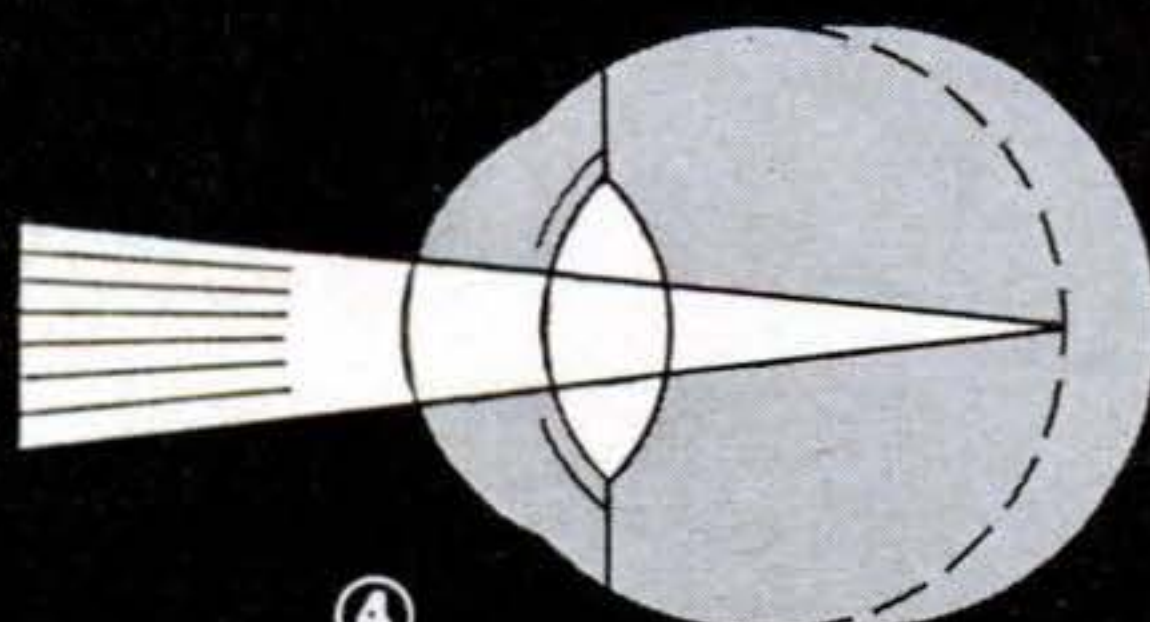
① NORMAL EYEBALL



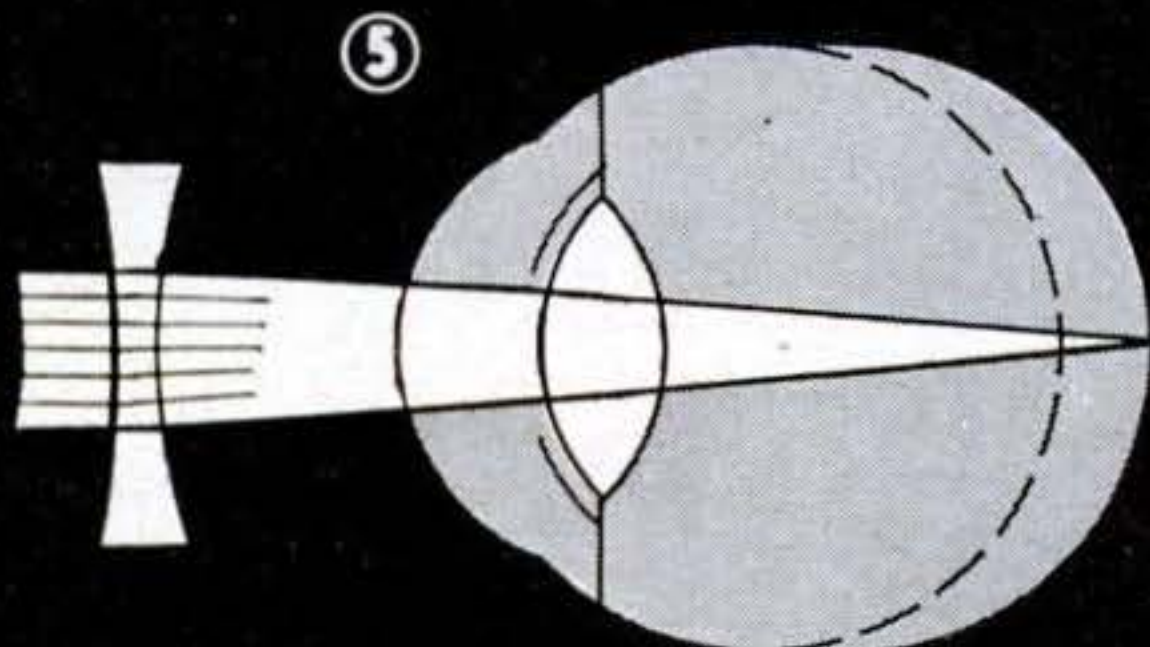
② EYEBALL TOO SHORT



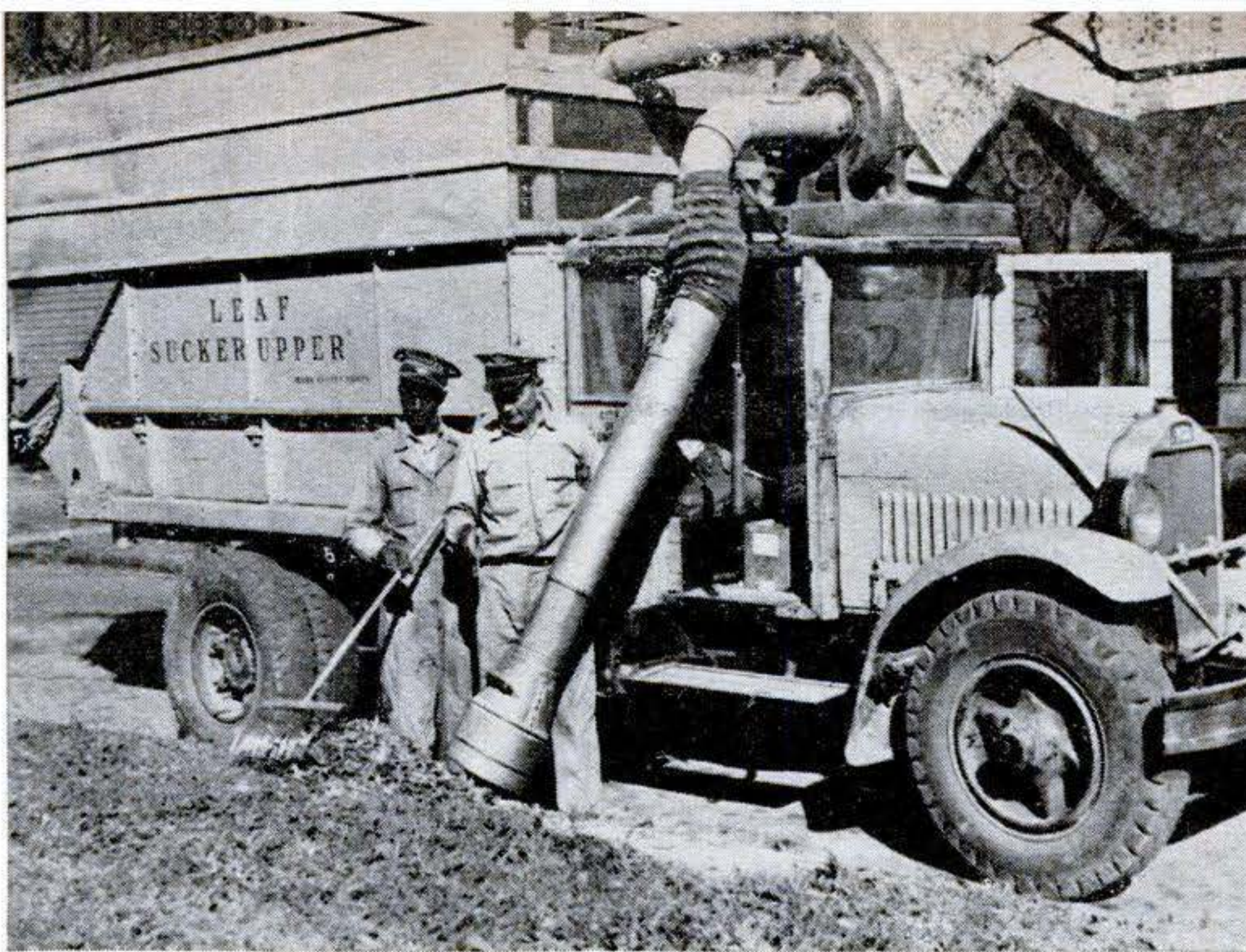
③



④ EYEBALL TOO LONG

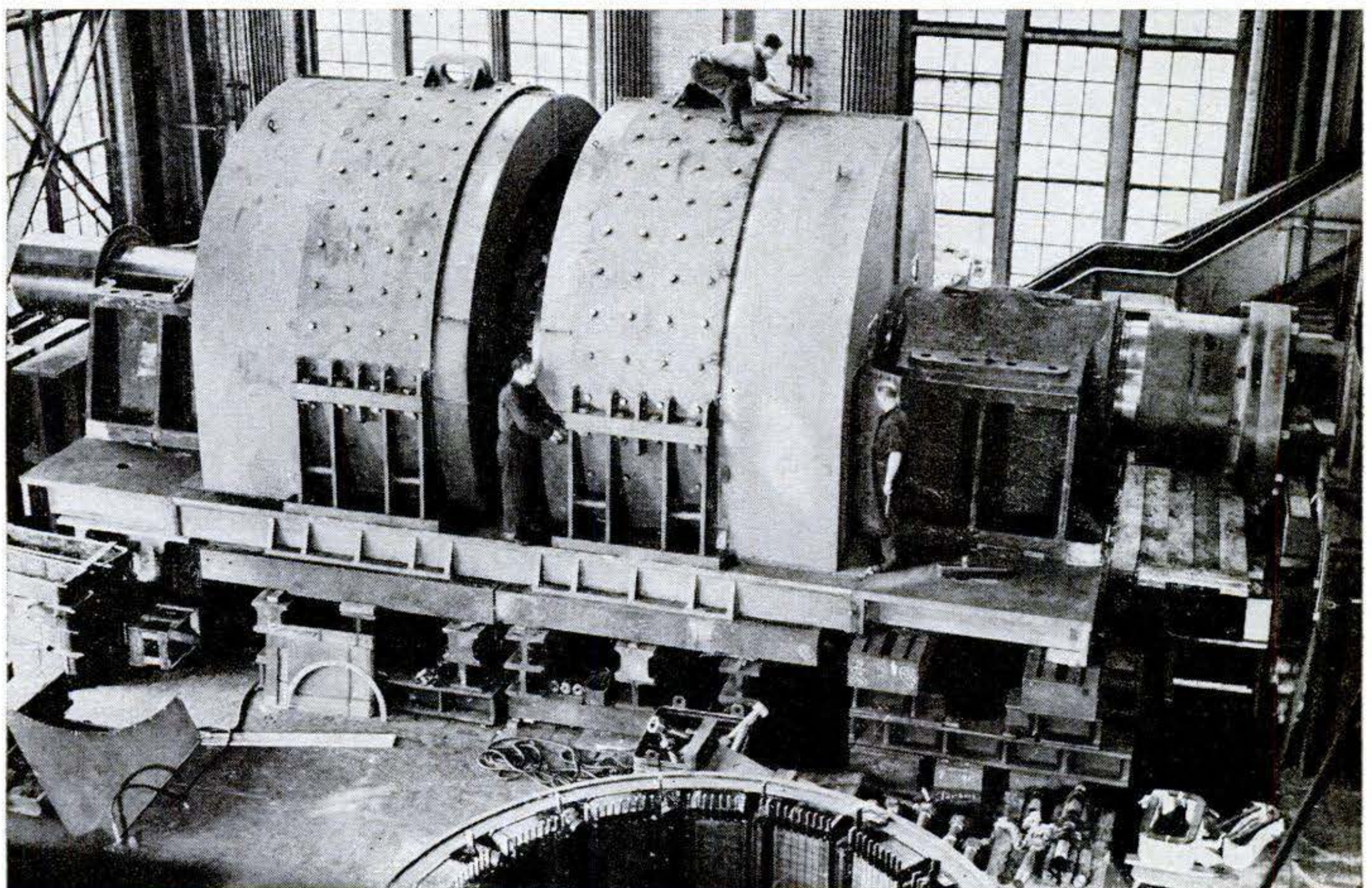
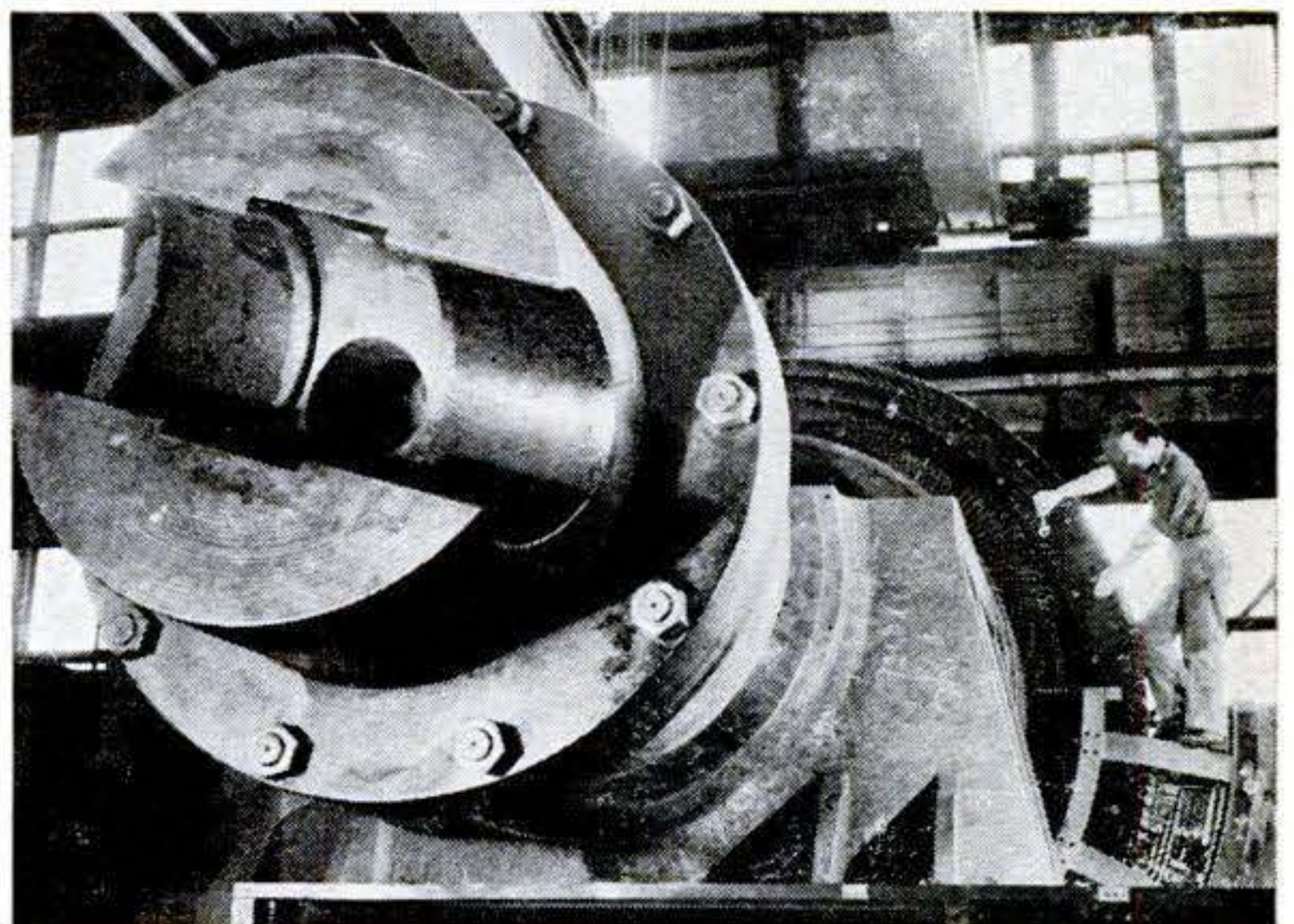


⑤



DEAD LEAVES, an autumnal problem in most towns, are disposed of easily in Columbus, Ga., by the "Leaf Sucker-upper," a machine that draws them up through a vacuum hose. This device—thought to be unique—is carried by a truck, and suction is created by a three-horsepower gasoline engine. Once inside the body of the truck, the leaves are crushed for immediate use as mulch in parks and gardens.

A MILLION POUNDS is the approximate weight of the world's most powerful electric motor, built at the General Electric plant in Schenectady, N. Y. The machine is shown in two views, as workers prepare it for installation in the largest steel plant west of the Mississippi, at Geneva, Utah. Here the electric colossus will drive a reversing rougher in a mill producing steel plates for shipyards and war plants on the West Coast. Rated at 7,000 horsepower, with a shaft speed of 25 revolutions a minute, it could hoist a destroyer to the height of a 15-story building in a minute.

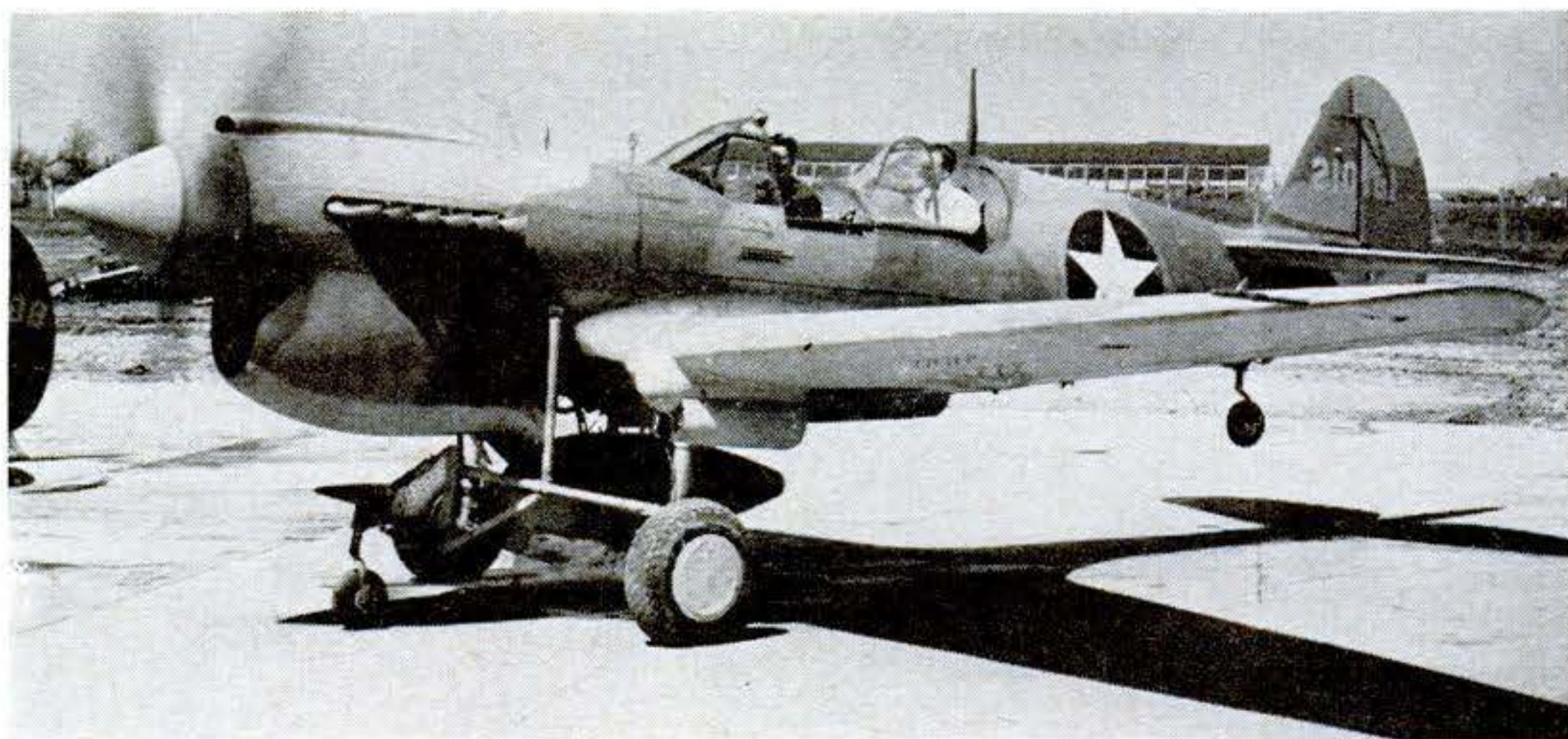




TWO-MAN CLASS-ROOM. To facilitate transition from advanced training to the complex job of flying a Bell Airacobra, this TP-39 was constructed. The student sits in a normal cockpit, the instructor in front. An added dorsal fin maintains stability, and dual controls provide safety. Any standard P-39 can be converted.

CAN'T BE FLOWN.

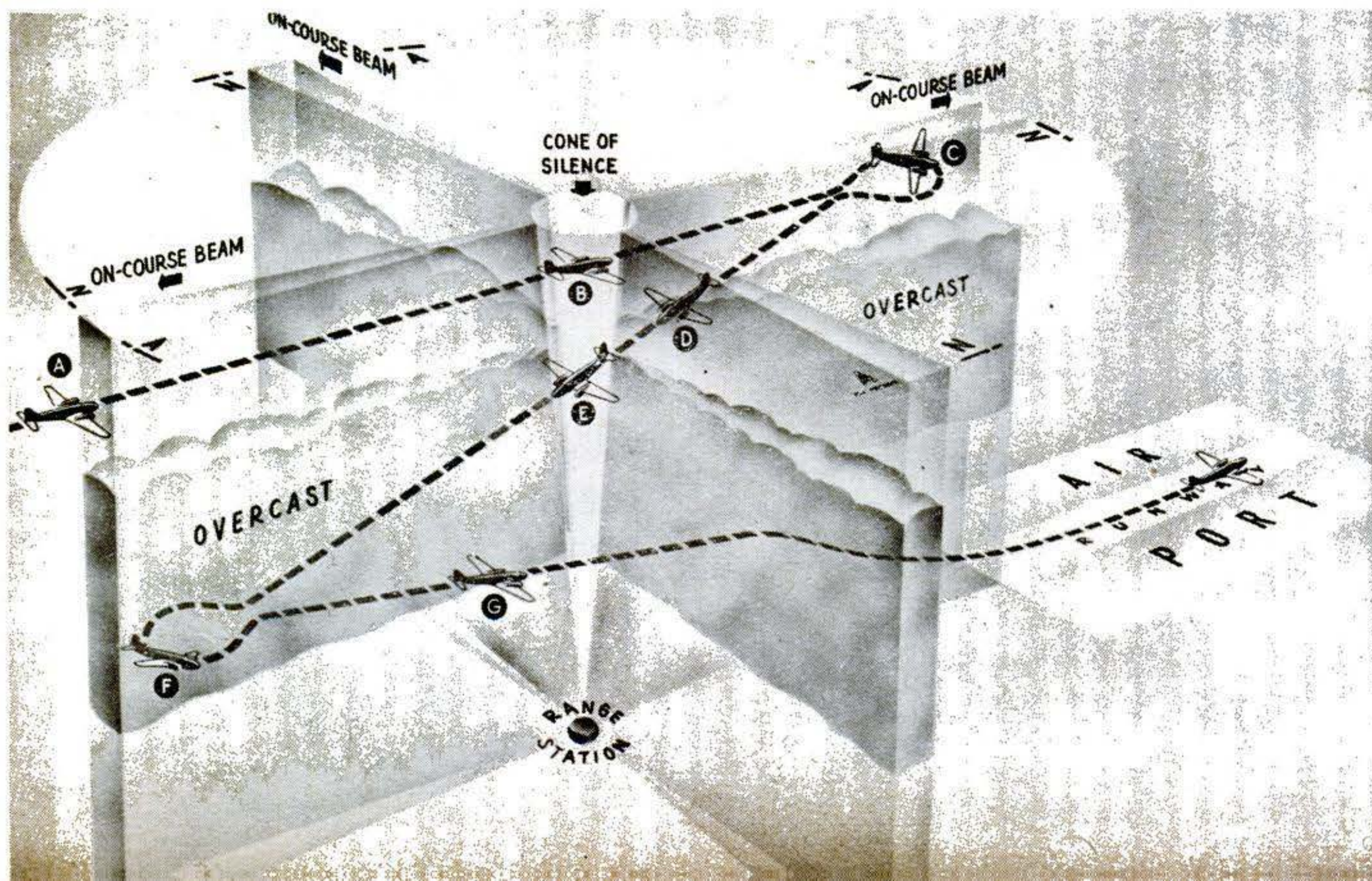
This nonflying P-40 was developed by Curtiss-Wright to solve the problem of teaching Army mechanics to taxi high-speed fighters. It has two seats, nontipping landing gear, and interphone for easy instruction. Dual controls correct mistakes made by novice ground pilots.

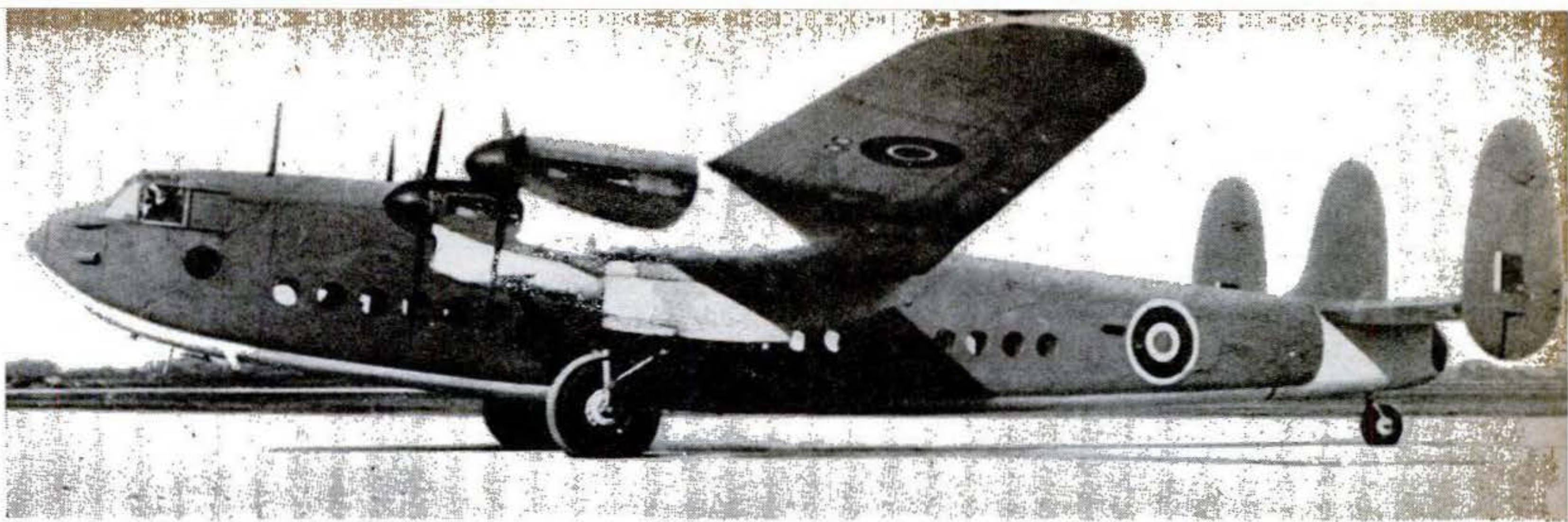


OVERCOMING THE OVERCAST.

This Western Airlines drawing clearly shows instrument-landing procedure through an overcast. On-course beam is a steady tone made by the dash of the dash-dot radio code letter "N" overlapping the dot of the dot-dash code letter "A." The pilot follows this tone through the location-giving "cone of silence" B, turning back at C and letting

down into clouds at D. At E, he again gets location and continues, to turn at the point F, predetermined by the speed of glide, and comes back along the same on-course tone to break through clouds at G at about 800 feet and approximately two miles from the field, right in line with the runway. Straying from the on-course beam is indicated by reception of "A" or "N" signal.





LANCASTER IN CIVIES. Proving that military aircraft can be converted to postwar transport use, this British Lancaster bomber conversion appears with altered tail and

fuselage. This sleek craft can carry 50 passengers, with baggage, in roomy comfort. It is the first postwar design from converted military aircraft.



BRITISH GRASSHOPPER. Built by Taylorcraft in England, this Auster III co-operation plane has done valiant service in many actions. It has a 130-hp. engine and does better than 125 m.p.h. The seats are side by side and controls dual. Transparent top gives all-around visibility. Span is 35 feet, length 22 feet, and height 7 feet.

SHUTTLE AMBULANCE for Navy and Marine casualties carries two badly wounded men in form-fitting wire stretchers loaded through a special door, right. Crew includes pilot, copilot, and nurse. This plane, named the Howard-Nightingale (after Florence Nightingale, the first war nurse), was basically designed by Ben. O. Howard, famous race pilot. It can operate 200 miles from its base. Engine is 450 hp.



Controlled Sound...

How music is used as an emotional powerhouse to spur weary workers and heal nerve-shattered fighters.

By JACK O'BRINE

THE young naval lieutenant sat staring into space. He'd been doing it for days. Now and again the corners of his mouth twitched; his frown deepened. He seemed oblivious of his surroundings. Since they flew him here from that Pacific battle area, he hadn't spoken. He just stared and, as he stared, a small group of nurses and musicians began to sing softly at the far end of the psychiatric ward. Unseeing, and unnoticed by the singers, he shifted uneasily in his chair. Then a strange thing happened.

Mrs. Harriet Ayer Seymour, director of the National Foundation of Musical Therapy, tells it this way: "When we played and sang, we hit some remembered theme, perhaps. At any rate, the young officer looked up. His eyes focused for the first time since he'd been at the hospital. Then he walked over and shook hands with one of the singers. He was started on the road to recovery. We had helped him."

Thousands of our fighters now find their way out of the fog of "traumatic neurosis"

—commonly known as shell shock—with the aid of music. It's becoming a vital part of the treatment at military hospitals, a potent partner of wartime medicine. And we can chalk it up as the second major achievement of controlled sound since that raucous trio of Hitler, Hirohito, and Mussolini forced us into the fray.

For months now, war plants the length and breadth of the land have been humming to tunes that make happier workers and increase production. Music in American industry soon may become mandatory, as it is in Great Britain. Scientists are proving to us that sound can be one of the dominant forces in our lives. Some of their claims for it are: Improvement of our sight and sense of smell; speeding respiration and pulse rate; raising body temperature; increasing muscular energy; reduction, delay, or increase of fatigue; instilling fear or building confidence; causing laughter, sadness, even tears.

Try, for instance, taking your pulse while you sing. Now change the tempo of the song, and you'll note an immediate change in pulse rate. Place before you a card with a smear of red paint on it. Gradually dim the lights until the red appears to be black. Turn up the lights slowly and note the point at which you're able to distinguish color. Now try it with your radio tuned to a waltz. You'll discover that with music your eyes pick up the red more quickly.



The emotional effect of hearing the voices of such stars as Gary Cooper and Ingrid Bergman, shown here in a scene from "For Whom the Bell Tolls," has been known to increase the body temperatures of the spec-

New Wartime Tonic

Before Pearl Harbor, our big defense plants were wary of sound-equipment salesmen. "You're crazy!" one manufacturer blurted. "Next you'll be wanting us to serve highballs." But that attitude now is as dead

as isolationism. Nearly 5,000 factories have installed music to work by. Sound application in industry has itself become a great industry.

Many of us are playing a part in sound

WHICH OF THESE SELECTIONS WOULD YOU CHOOSE TO HELP PEOPLE WORK BETTER?



Experiments show that some kinds of music speed production in war plants, while others retard it. Paired below are alternative selections. Select those you think would be best to play, then check your answers on page 226.



1 { "Semper Fideles"
"Hike Notre Dame"

2 { "Nearer My God to Thee"
"You Are My Sunshine"

3 { "Merry Widow" Waltz
"Beer Barrel Polka"

4 { "William Tell" Overture
"Remember Pearl Harbor"

5 { "Auld Lang Syne"
Tschaikovsky's "Piano Concerto No. 1"

6 { "Wreck of the '97"
"Sweet Leilani"

7 { "The Star-Spangled Banner"
"Ah! Sweet Mystery of Life"

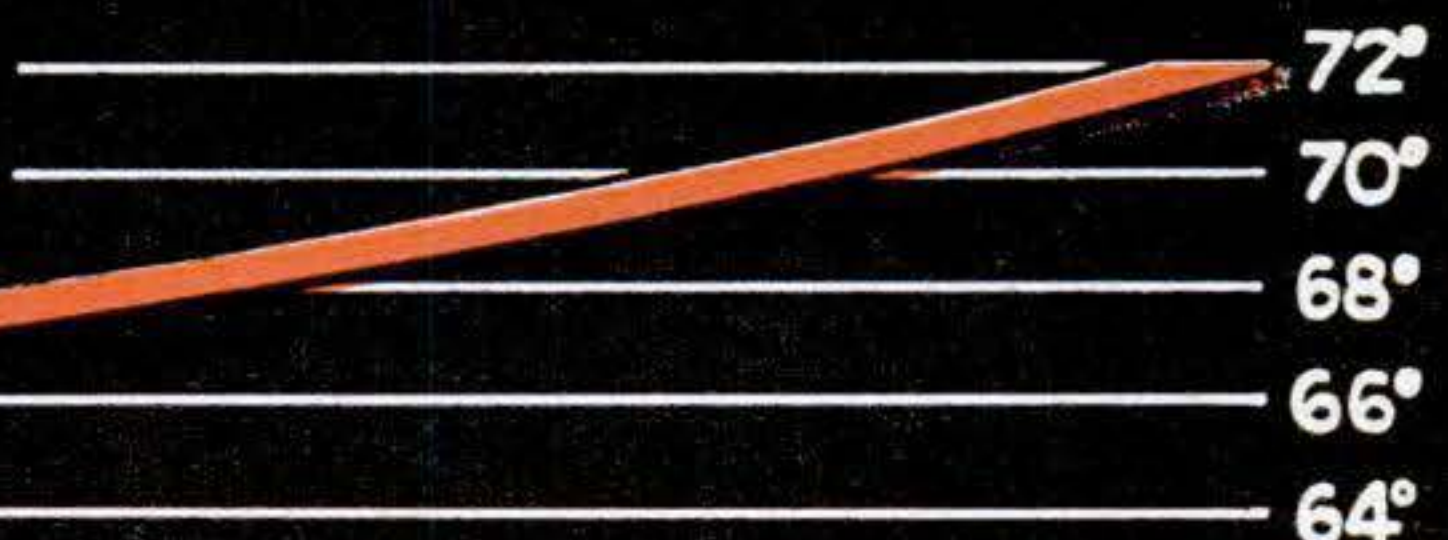
8 { "Irish Washerwoman"
"One Alone"

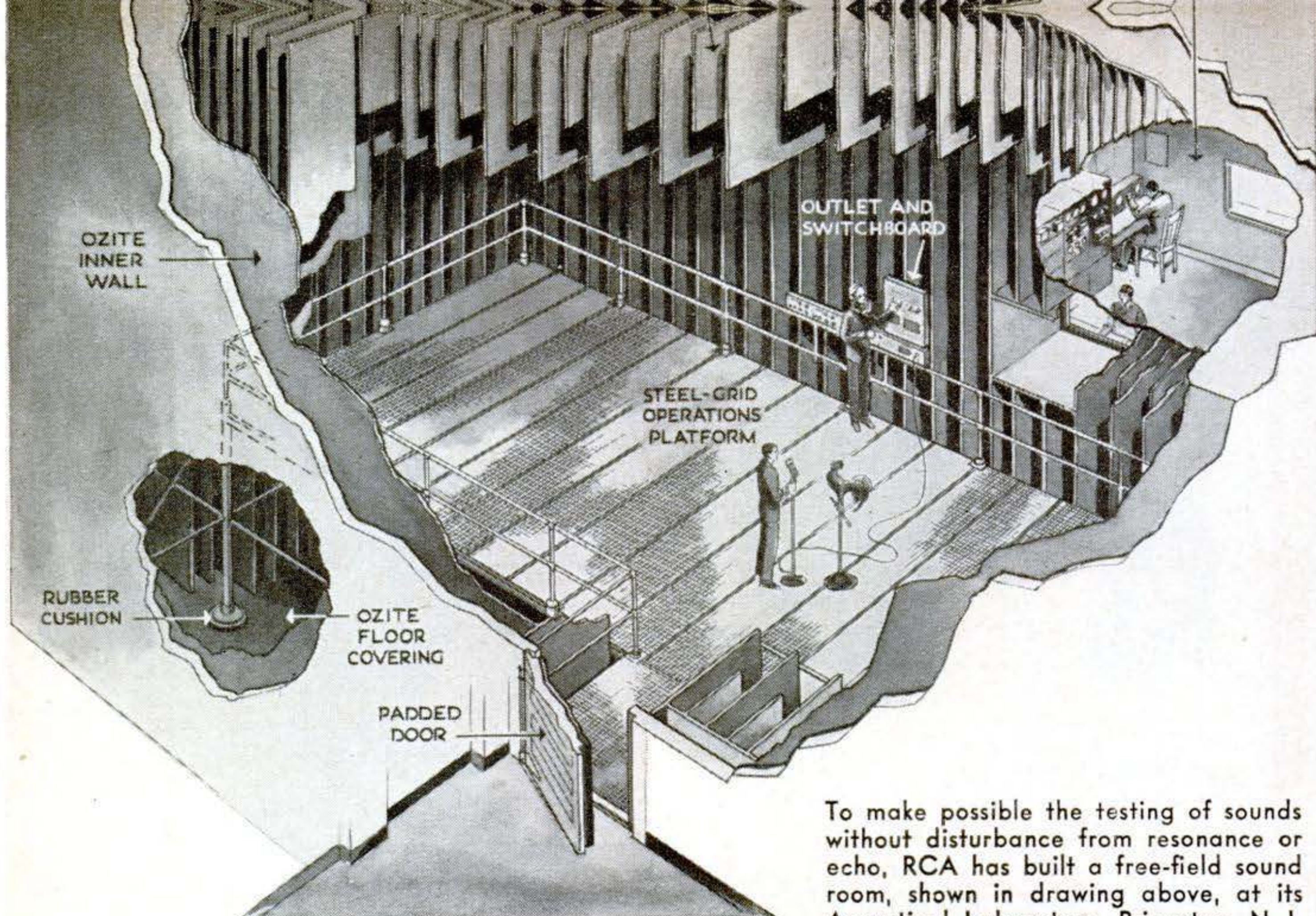
9 { "Home on the Range"
"Tiger Rag"

10 { "Brazil"
"Why Do I Love You?"



tators so much as to raise the temperature of the theater eight or 10 degrees





To make possible the testing of sounds without disturbance from resonance or echo, RCA has built a free-field sound room, shown in drawing above, at its Acoustical Laboratory, Princeton, N. J.

research without realizing it. For only by observing our reactions can science find out what to expect from different types of sound. Hundreds of persons in schools, factories, and public places have been "tapped" for sound effect.

In one instance, sound researchers seeking to discover the difference in audience reaction to jazz and classical music leased a large hall in New York. They wired it so that they could record heartbeats, pressure grip of chair arms, and foot tapping of a cross section of the audience. Moreover, they recorded facial expressions with hidden cameras. The musical program consisted of two jazz numbers and two classical pieces played 25 times each. At first the jazz increased the pulse rate by $2\frac{1}{2}$ beats a minute, while grip strengthened two percent and tapping jumped six a minute. But, as the last jam number jived to an end, grips had wilted and tapping long since stopped. The classical music, on the other hand, got only a mild reaction at the start but wound up ahead in popularity, stimulating both pulse and arm gripping.

In a Brooklyn junior high school, 1,500 students contributed unknowingly to sound research when they increased the temperature of the school auditorium 15 degrees during a lively session. It was a cold day. The building superintendent took pains to have the auditorium amply heated. As an added precaution, he was on hand to check thermometers. His amazement mounted

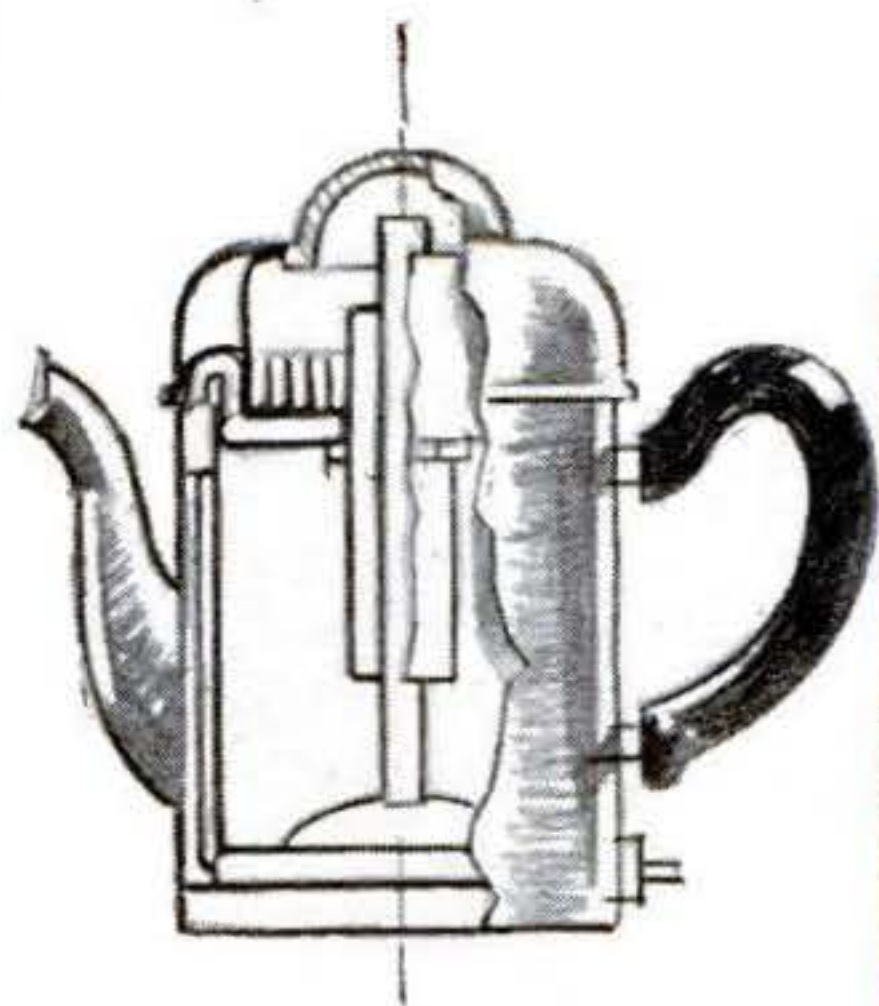
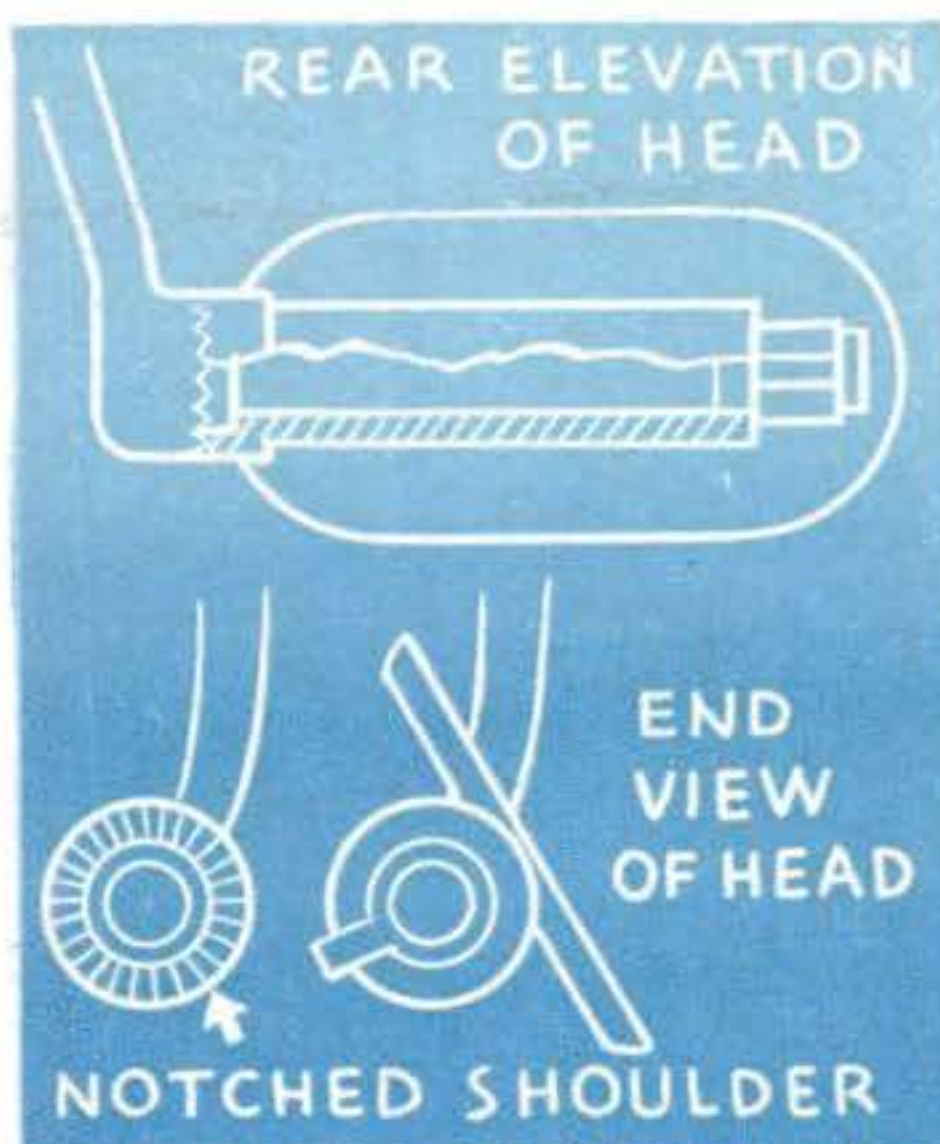
with the mercury as the program approached its climax. He noted that with every exciting song and speech the room got warmer. His findings went to other building superintendents, including a man in charge of one of the world's largest motion-picture theaters. Now scores watch thermometers, alert to sound that may send temperatures rocketing.

Such incidents come to mind when sound experts tackle problems in our daily life. The important thing in providing music to work by is to maintain emotional and physiological control. That means not only creating an atmosphere conducive to enjoyment but actually relieving fatigue. Most helped are the employees doing light, repetitious tasks on the assembly line. They expend great quantities of nervous energy combatting monotony. Music properly applied acts as a mental tonic, driving out fatigue and boredom on notes of song. The job then takes on new importance, accidents decrease, absenteeism drops, morale mounts. Moreover, it has been noted that introduction of music puts an abrupt end to strife and bickering among employees.

But there are pitfalls in sound application that can prevent these good results. To root these out and spotlight them for the guidance of war-plant managers, Stevens Institute of Technology, Hoboken, N. J., has worked closely in experiments with RCA and Muzak, chief suppliers of sound equipment in industry. *(Continued on page 226)*

new ideas from the inventors

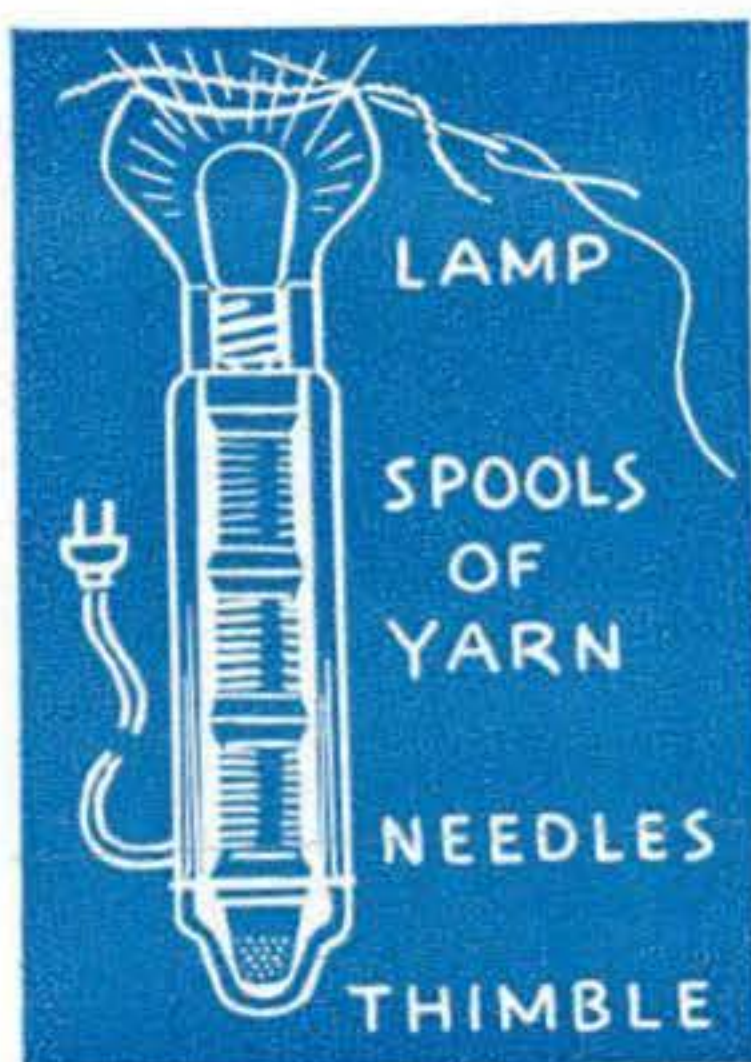
A GOLF CLUB with an adjustable head solves the caddy problem of the wartime golfer, formerly weighed down by a heavy bag. Invented by Charles V. Winter, of Barrington, Ill., the club has a notched shoulder at its shank end, to which the head is secured at the proper angle by a fast-operating nut. Transformed into a mashie, niblick, and so on, it can even be used in reverse by left-handed golfers.

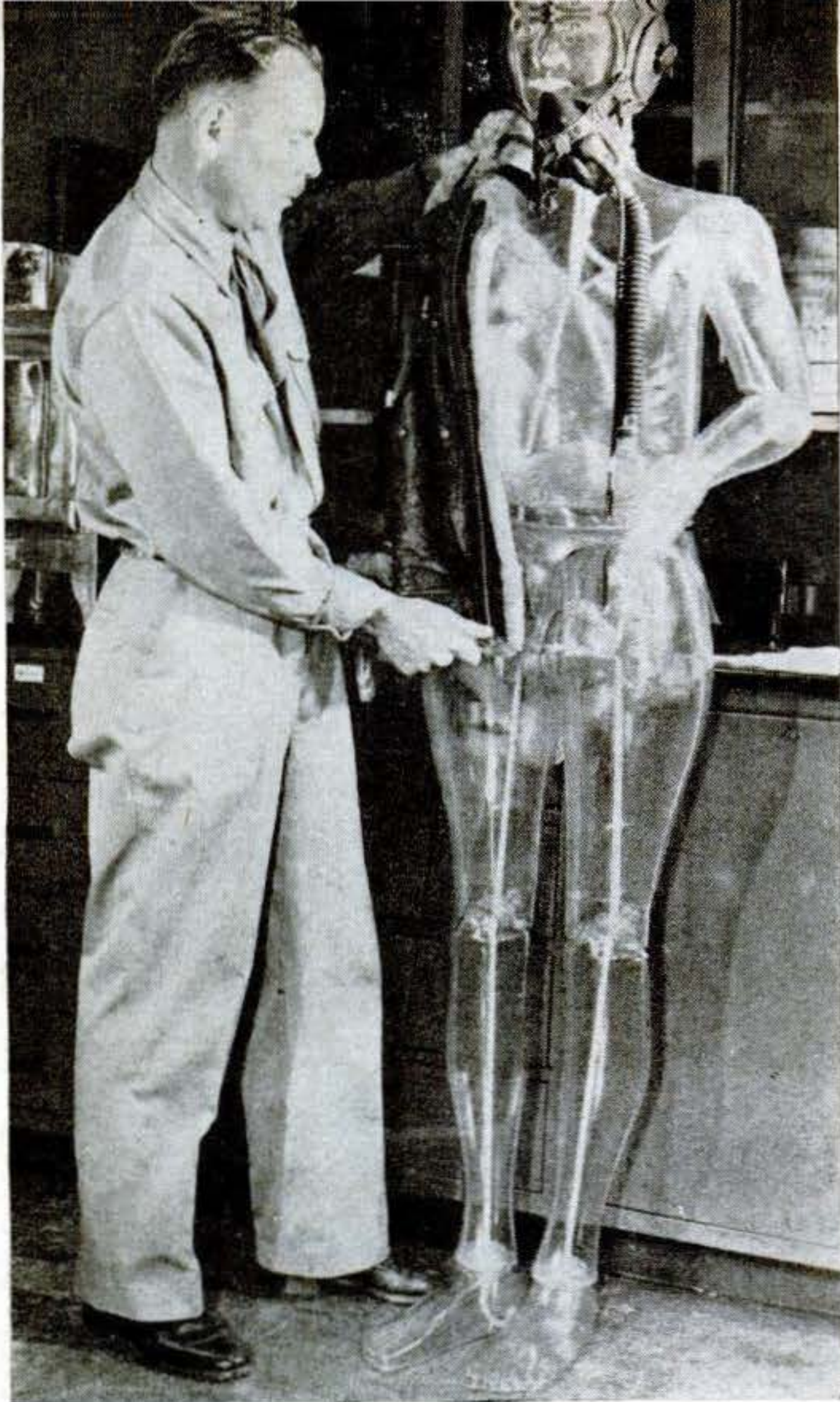


GREEN COFFEE can now be roasted an instant before brewing in a combination roaster and percolator designed for epicures by Gustave L. Kayden, Woodmere, N. Y. Gas or electricity heats the device, roasting

the raw coffee in an upper compartment and heating the water in a lower one. By the time roasting is done, the water has boiled and, passing upward through a pipe, filters down through the grains.

DARNING is made easier by an illuminated plastic darning egg. Material to be mended is stretched over a supporting head, which contains a small light bulb powered through a cord from a convenient outlet. The hollow handle holds yarn, needles, and thimble. Alonzo J. Bloodgood, of Middlebury, Conn., is the inventor.





TRYING OUT ROCKETS as antiaircraft and incendiary shells, Germans have produced the captured weapon shown above. The odd missile is fired from the crate in which it is shipped.

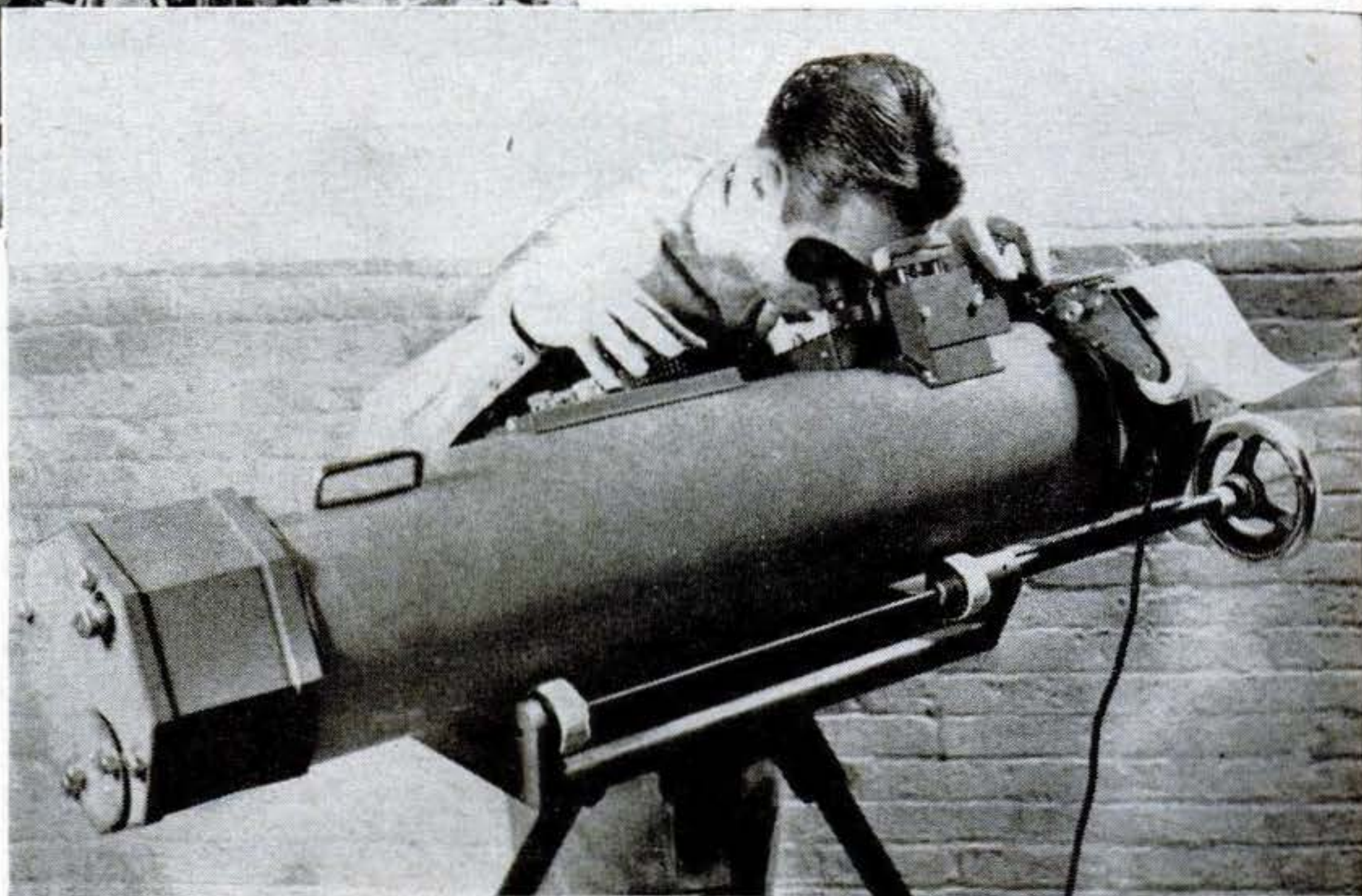
MANNEQUINS OF PLASTIC serve as models for designing planes and airmen's costumes. At left, one of the transparent figures is being fitted with a winter flying jacket. Others test cockpit and turret dimensions.



A real anti-aircraft height finder, like this one seen in action in the South Pacific, is an extremely difficult instrument to make

This stereoscopic trainer, operated in the same way, releases real ones for combat use. The tape at far right records user's score

ANTIAIRCRAFT MEN now learn height and range finding with improved "stereoscopic trainers." Gazing through twin eyepieces at a target, such as a maneuvering plane, a student tries to keep the images combined and in focus with hand controls. His automatically recorded score helps him to correct errors.



Health-building foods, right, often absent in prison fare, are featured in the "invalid package" sent by the American Red Cross to ailing Yanks in enemy prison camps

Volunteer workers pack the boxes at a Red Cross depot in New York City. Cigarettes and soap are among the items that prisoners prize highly



POWDERED MILK

PRUNES

COCOA

POWDERED SOUP

POWDERED BOUILLON

BISCUITS

SUGAR

CHEESE

LIVER PASTE

CIGARETTES

SOAP

COFFEE

ASCORBIC ACID

CORNED PORK

BUTTER

CAN OPENER

HAM AND EGGS

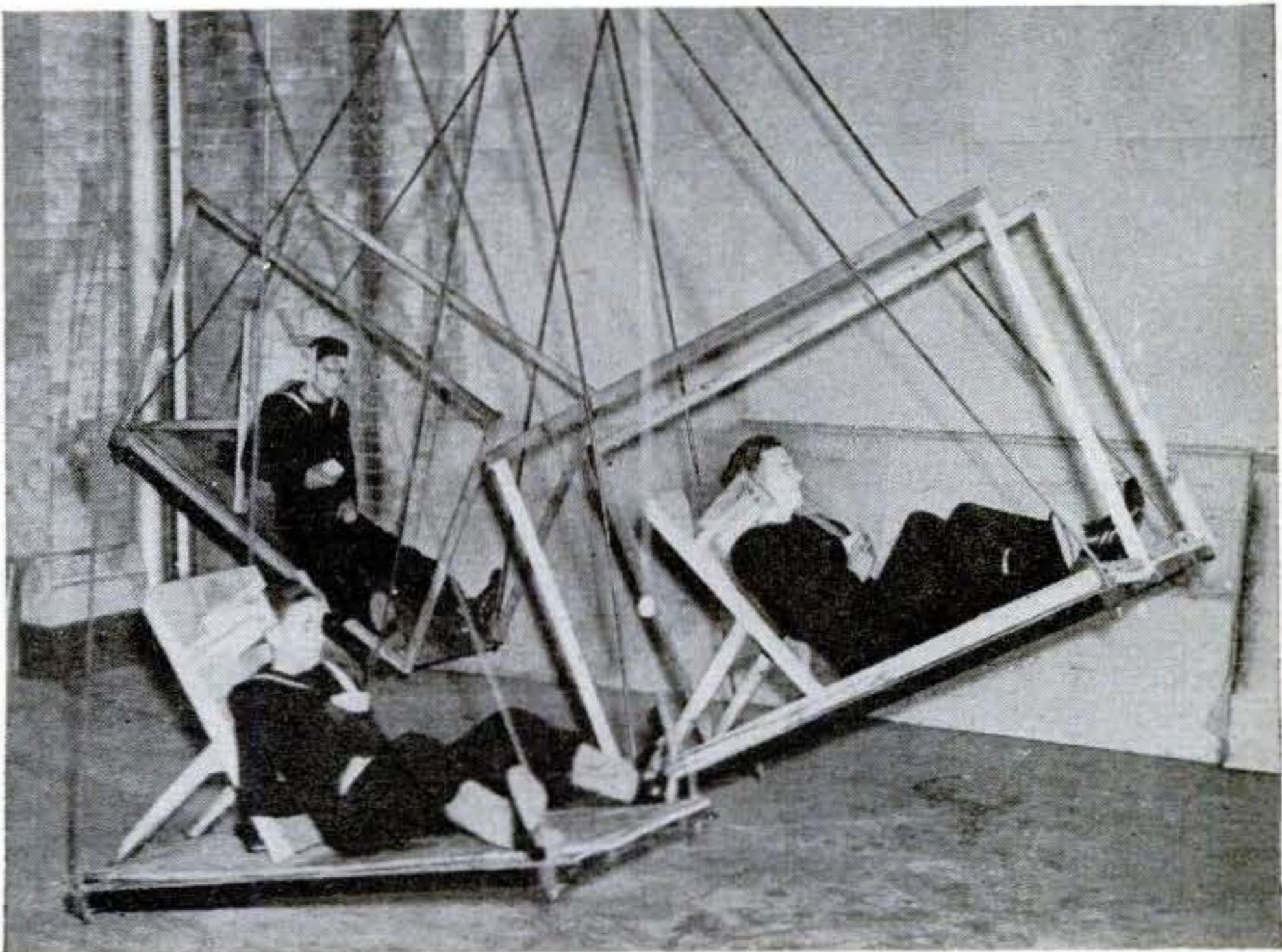
GRAPE JAM

CONTENTS OF PACKAGE

AMERICAN RED CROSS
PRISONER OF WAR
INVALID FOOD PACKAGE
NO. 1
FOR DISTRIBUTION THROUGH
INTERNATIONAL RED CROSS COMMITTEE

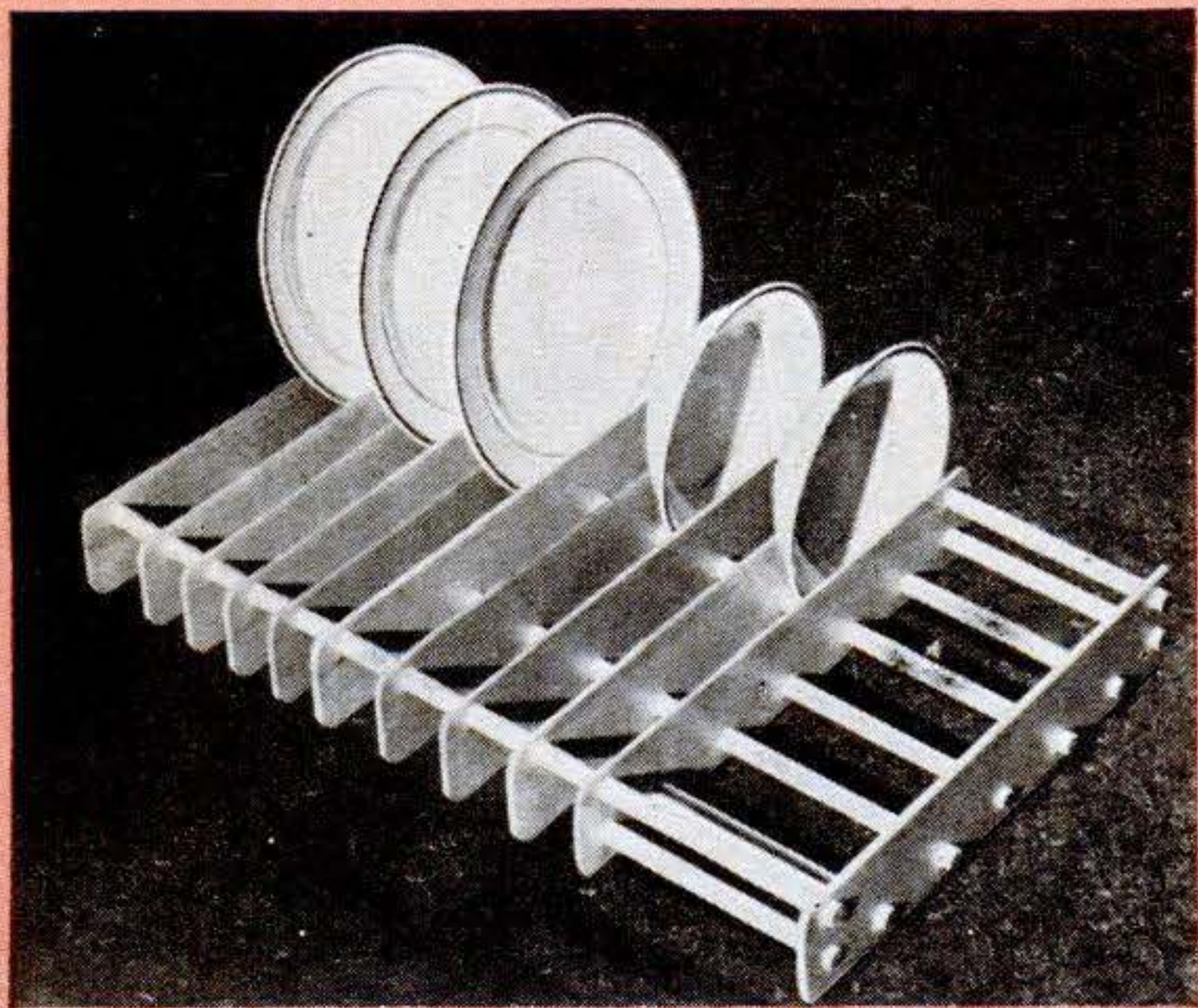
AMERICAN WAR PRISONERS who are recovering from wounds or illness in enemy camps now receive special food packages every week through the American Red Cross. The "invalid" package differs from the standard food package in that its contents, shown above, are specially selected for their value in building up health. Its weight is approximately the same as that of the standard package.

SEASICKNESS is now cured in three out of four cases with pills developed by the Royal Canadian Navy and the Montreal Neurological Institute. Aiding the research were sailors who swung on platforms, at right, which efficiently developed all the symptoms of this ancient ill. The new pink pills are effective for eight hours. Taken two hours before sailing or in rough weather, they will greatly help in landing invasion troops on their beachheads in good fighting condition.





LARGE POCKETS for holding polish, cloths, or cleaners are sewed into this special apron



ALL-WOODEN DISH DRAINERS like the one above are assembled with waterproof glue and finished with a durable coat of clear varnish

WATER IS AERATED as it passes through the ingenious faucet nozzle shown at the right in 1/1000-second action photos and a close-up. First broken into spray by a perforated disk, it draws air through intake slots in the side of the nozzle and is mixed in going through a fine mesh. The entrained air makes the water produce rich lather and rinse quickly, and the bubbles render it splashless, as in the photos at right of water gushing on a light bulb . . .

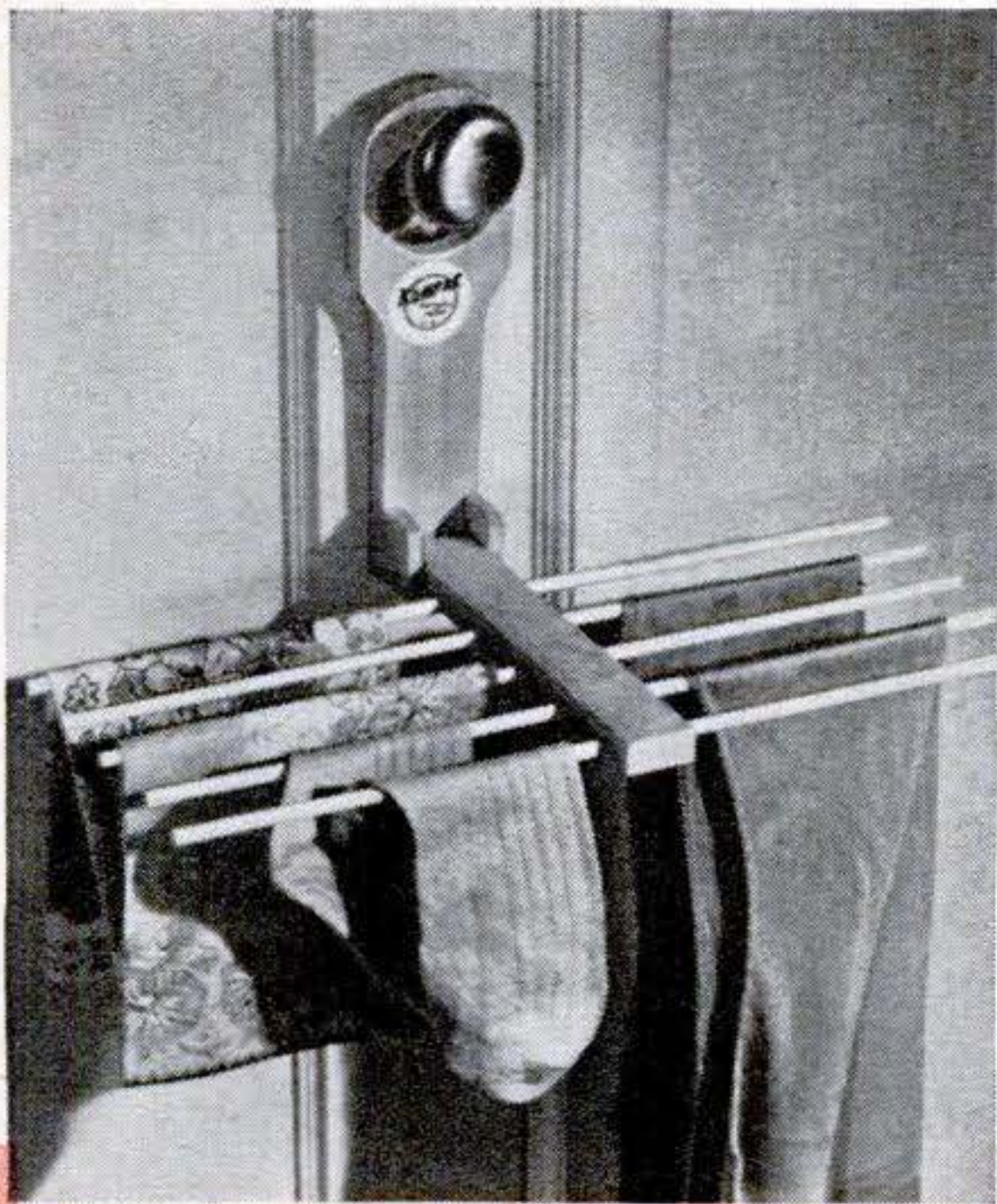
AIDS TO

Modern Living

PROTECTIVE LACQUER that keeps bright metals from tarnishing is now available in a brush-top tube. The unit is especially useful for lacquering small objects

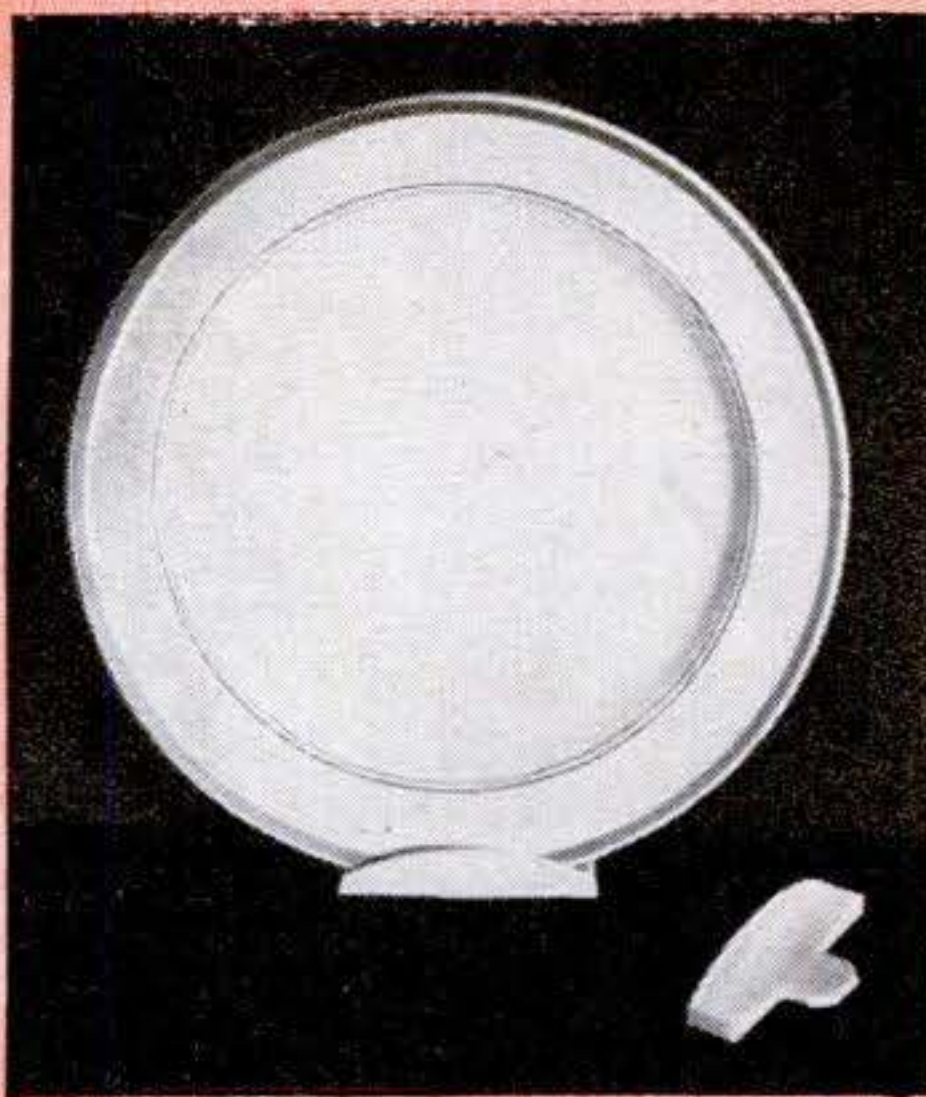
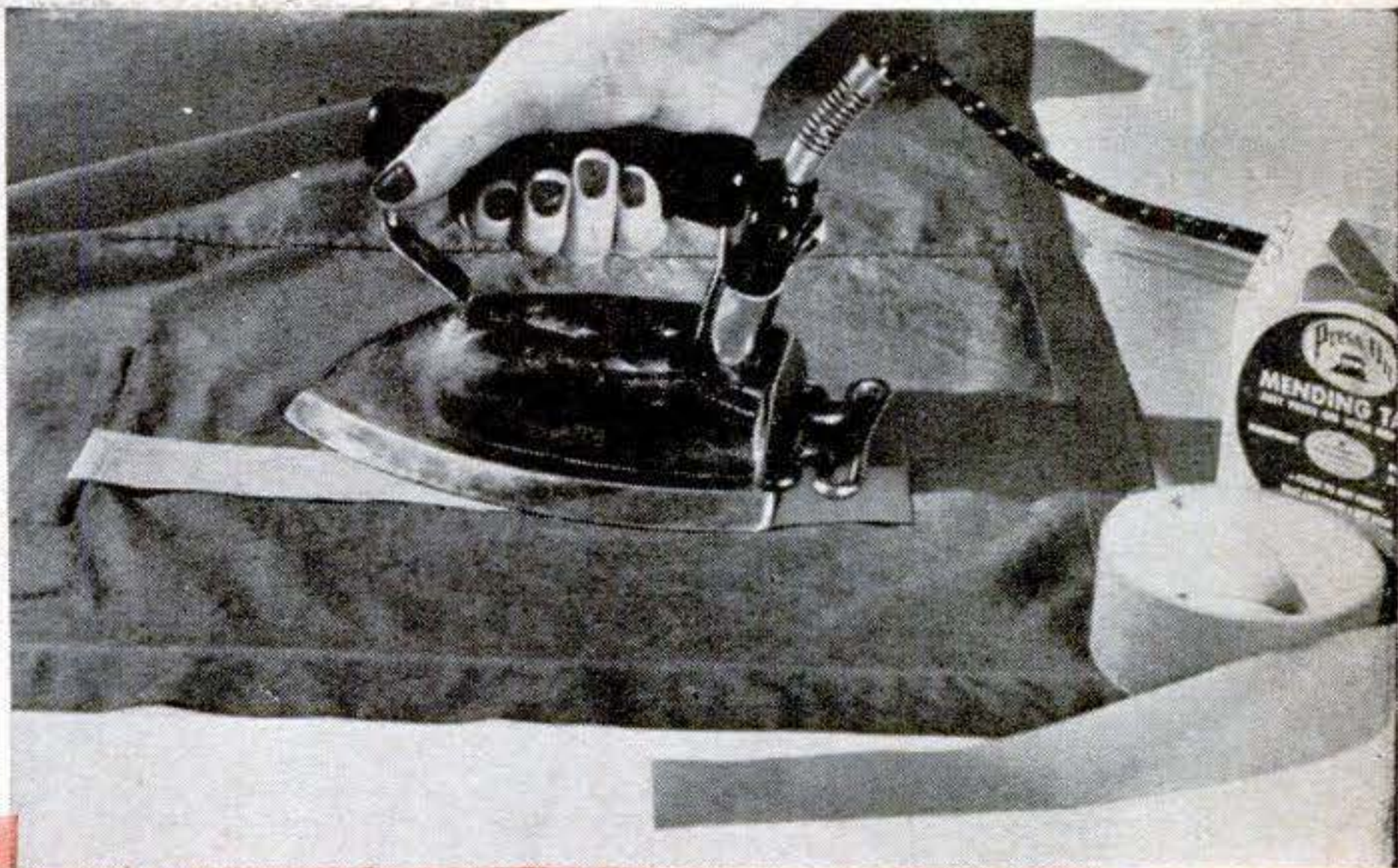


. . . and above flowing into a glass. These big bubbles vanish immediately and leave the water clear. The device is scheduled for production on the lifting of priorities. Its principle has been used also to homogenize milk, to whip table cream, and also to mix liquids in an emulsion

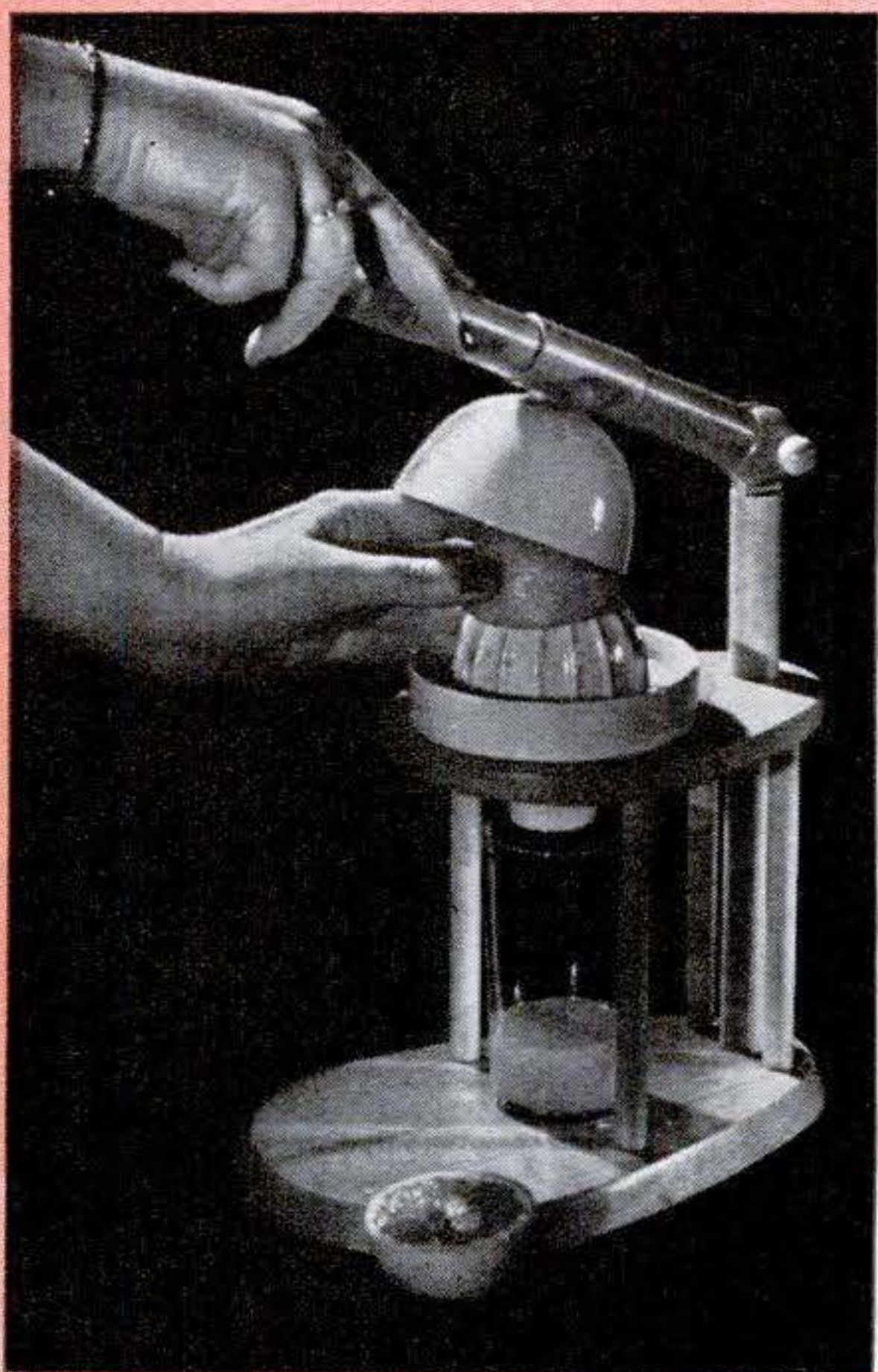


THIS PORTABLE DRYER can be taken apart and packed in a 10½" by 8⅞" box, or tucked away in a traveling case. It weighs only 8 oz., but will hold a lot

MENDING TAPE of the press-on type can be obtained in a grade heavy and strong enough to patch tears in awnings and other stout canvas materials. Water-repellent, the tape can be used also on torn raincoats. It is applied with a hot iron



YOUR FINEST PLATES can be displayed safely for all to admire on a sideboard or shelves if you stand them upright in these little holders made of a white plastic



JUICY RETURNS can be expected from this orange squeezer made all of wood except for its fluted porcelain reamer. Its blond, highly polished finish makes the squeezer good looking enough to be used in the dining or living room, and grapefruit, lemons, and limes can all be pressed dry in the gadget with ease. Holes in the reamer strain the juice

QUICK-CHANGE ARTISTS will marvel at the speed with which you can swathe Junior in these soft paper diapers. Just snip them from a roll, arrange them in a special knitted covering, and encase the baby in a jiffy



Trouble-Shooting with a

SIMPLE CHECKUPS HELP YOU TO FIND ELECTRICAL FAULTS AND LOSSES THAT CAN CAUSE MYSTERIOUS AUTO AILMENTS

By Ralph Rogers

IF AN experienced auto mechanic could have but one instrument to aid him in diagnosing electrical troubles, the chances are that he would pick a voltmeter. Properly used and interpreted, it can help in locating many annoying car ailments—hard starting, dim or overbright lights, undercharged battery, and similar difficulties—which might otherwise be hard to track down.

As a trouble-shooting tool, a voltmeter is preferable in most cases to an ammeter because wires and connections do not have to be disturbed. When an ammeter is used for testing, the cause of a difficulty is sometimes removed when the ammeter is connected, with the result that the repairman does a little head-scratching. Similar puzzlement may occur when the trouble comes from a loose connection at the point where the ammeter is placed in the circuit. The difficulty disappears after the repairman restores the connection snugly, but he is still in the dark about just *how* he fixed it.

The difference between an ammeter and a voltmeter is that the former measures the quantity of current flowing through a cir-

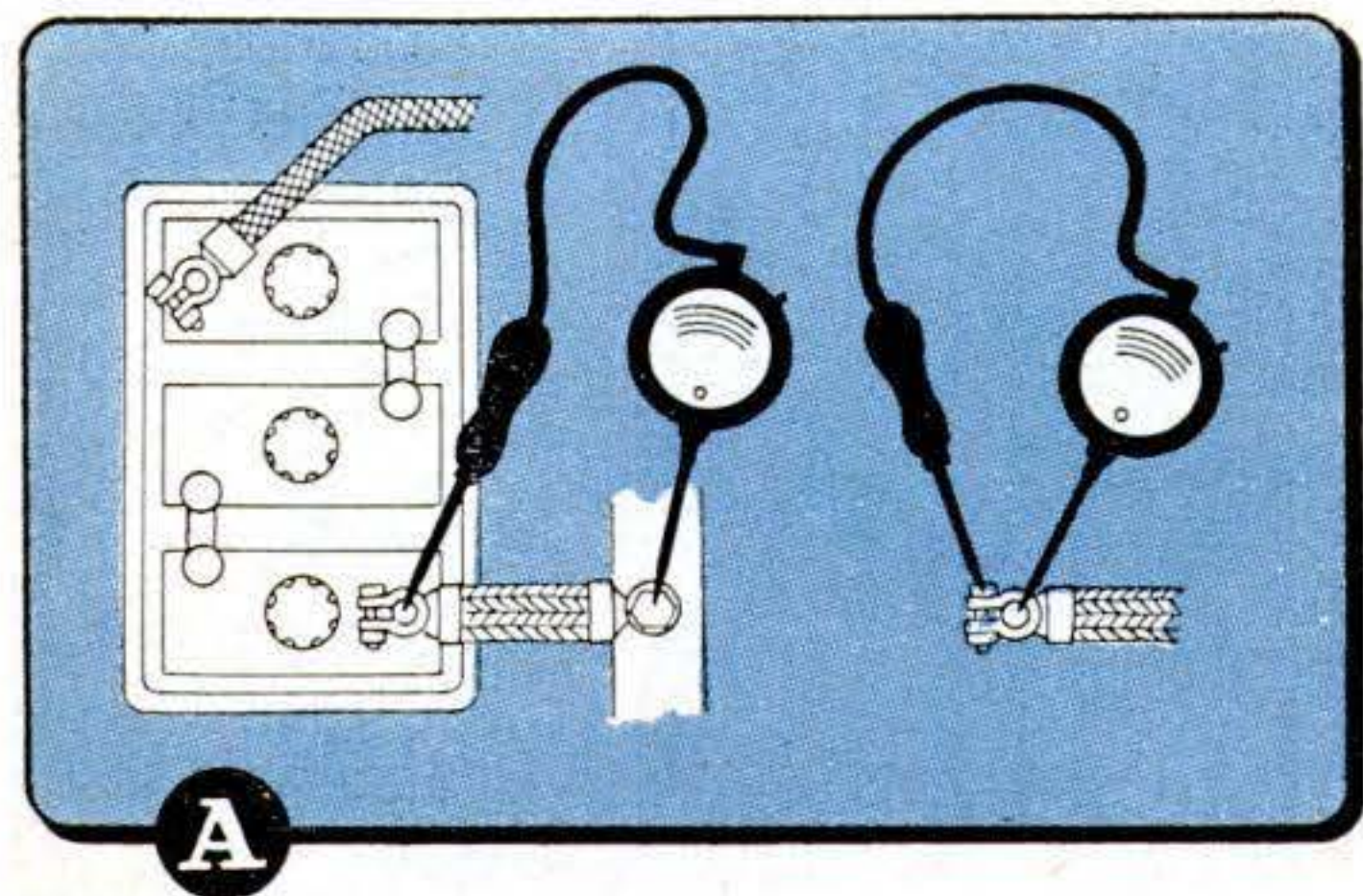
cuit, while the voltmeter indicates the pressure available to push it along. The current actually flowing through a circuit is wholly dependent on voltage. In other words, no voltage, no current; low voltage, low current; too high a voltage, too much current. It is this fact which makes the voltmeter so useful an instrument, for if it indicates that insufficient voltage reaches a certain electrical unit, insufficient current passes there too.

There are two basic ways to use a voltmeter in automotive testing. The first is to connect it *across* a circuit, whereupon it indicates the total voltage at that point. The voltmeter in the photo on the facing page is being used in this way to test one cell of a storage battery.

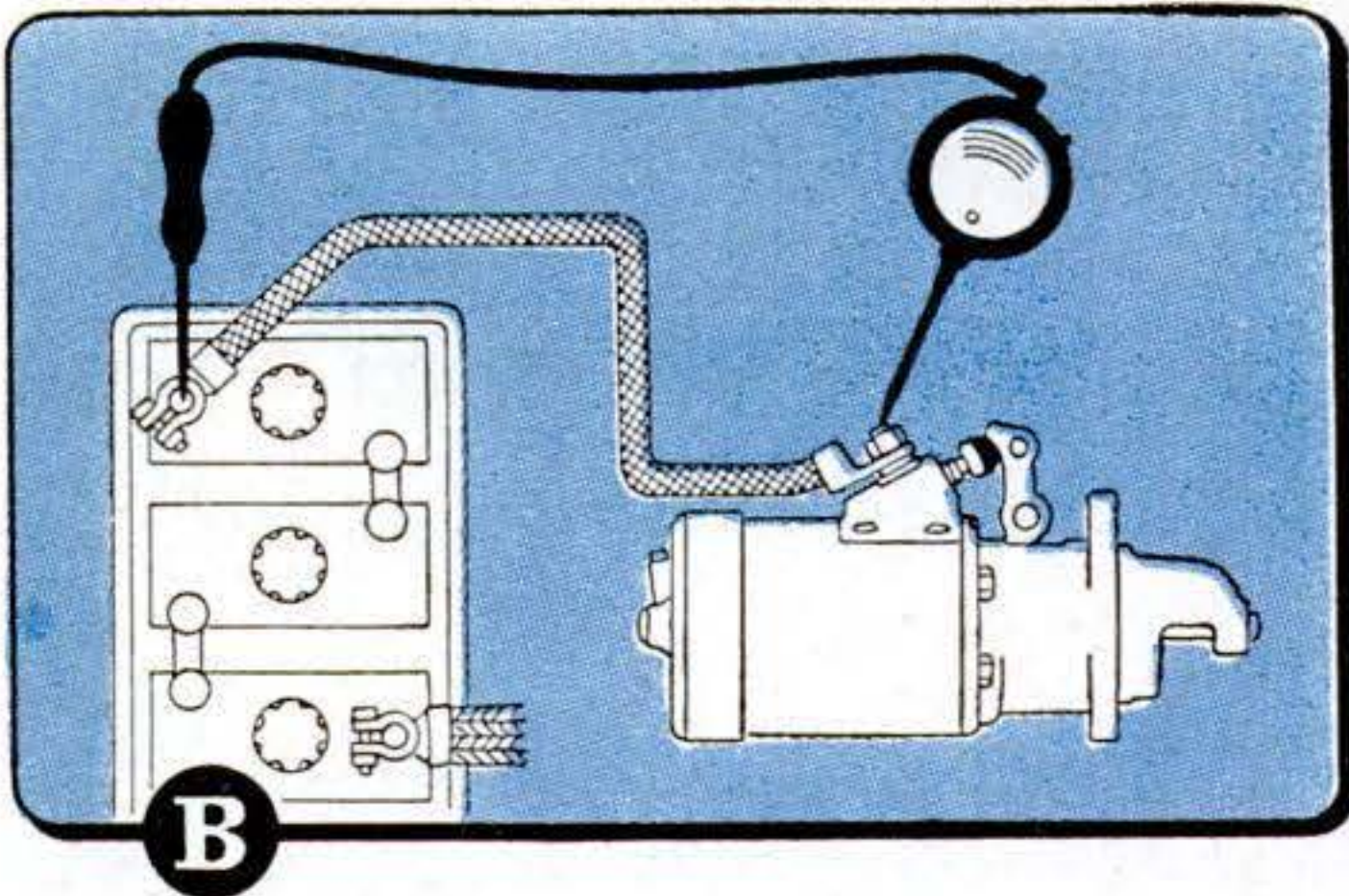
If the meter is connected *in parallel with part of a circuit* in which current is flowing, it then indicates the voltage drop, or loss of electrical pressure, in that portion of the circuit. When connections are clean and tight, and when the wire is in good condition and of proper capacity, there will be almost no voltage drop and the meter will read close to zero. But if there is any defect in the electrical conductors, the resistance created will cause a larger voltage drop. The best conductor in the world will cause some drop, but in autos any reading higher than .2 volt is worth investigating.

The handiest type of voltmeter to use is one which has a dual range—one scale reading from minus .5 to plus 3 volts in graduations of .1 volt, and the other scale reading from zero to 10 volts in graduations of .2 volt. Either range is available by the use of

HOW TO TEST THE CIRCUITS OF A CAR IN ORDER TO TRACE



Use these connections in testing a battery ground strap for voltage drop. Read the low scale of the meter when the starter is turning. If the drop is more than .1 volt, there is excessive resistance



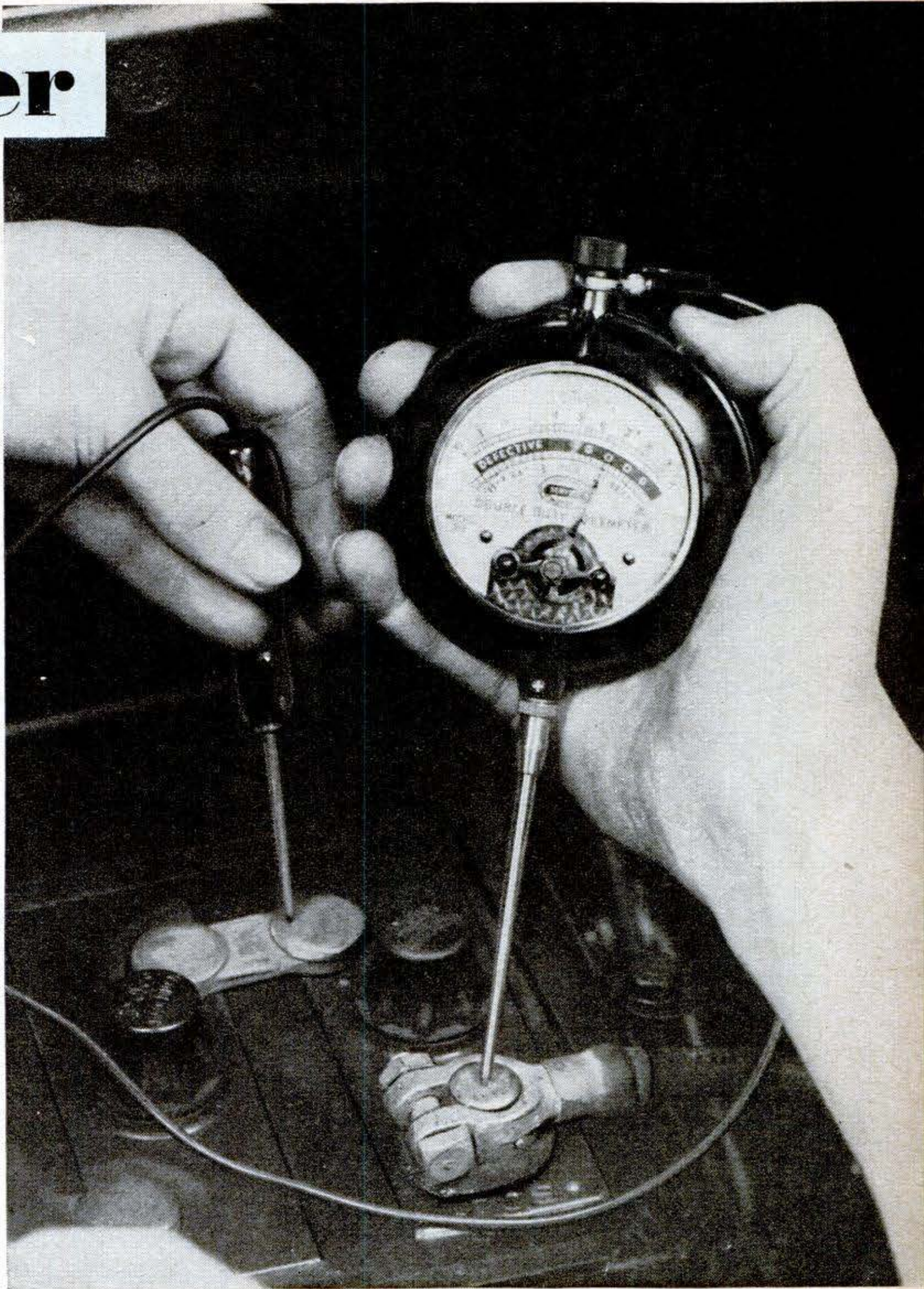
To check the starter cable and its terminal connections, try this test with the starter in use. The reading, on the low scale, should not be over .1 volt. Place prods on the terminals, not the lugs

Voltmeter

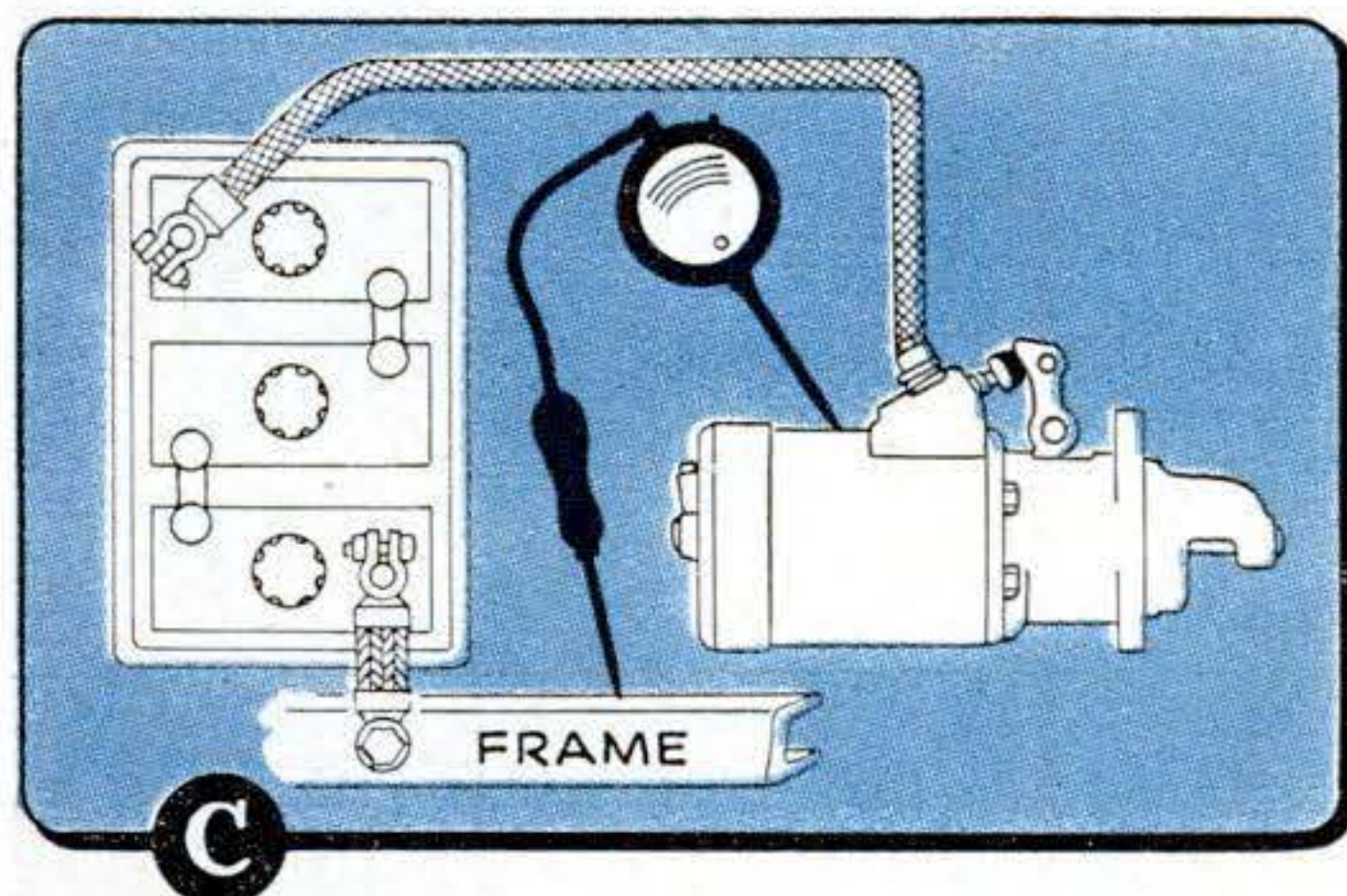
a button on the instrument. Form the habit of testing first with the high range—that is, without pressing the button—and then, if the reading is less than 3 volts, use the lower range. Otherwise excessive voltage may damage the instrument.

In practically all cars, a grounded-return wiring system is used, with the chassis acting as a path for completion of the circuits. Therefore the battery ground strap, connected to the engine, transmission, or frame, is an integral part of the electric system and should not be ignored in your tests.

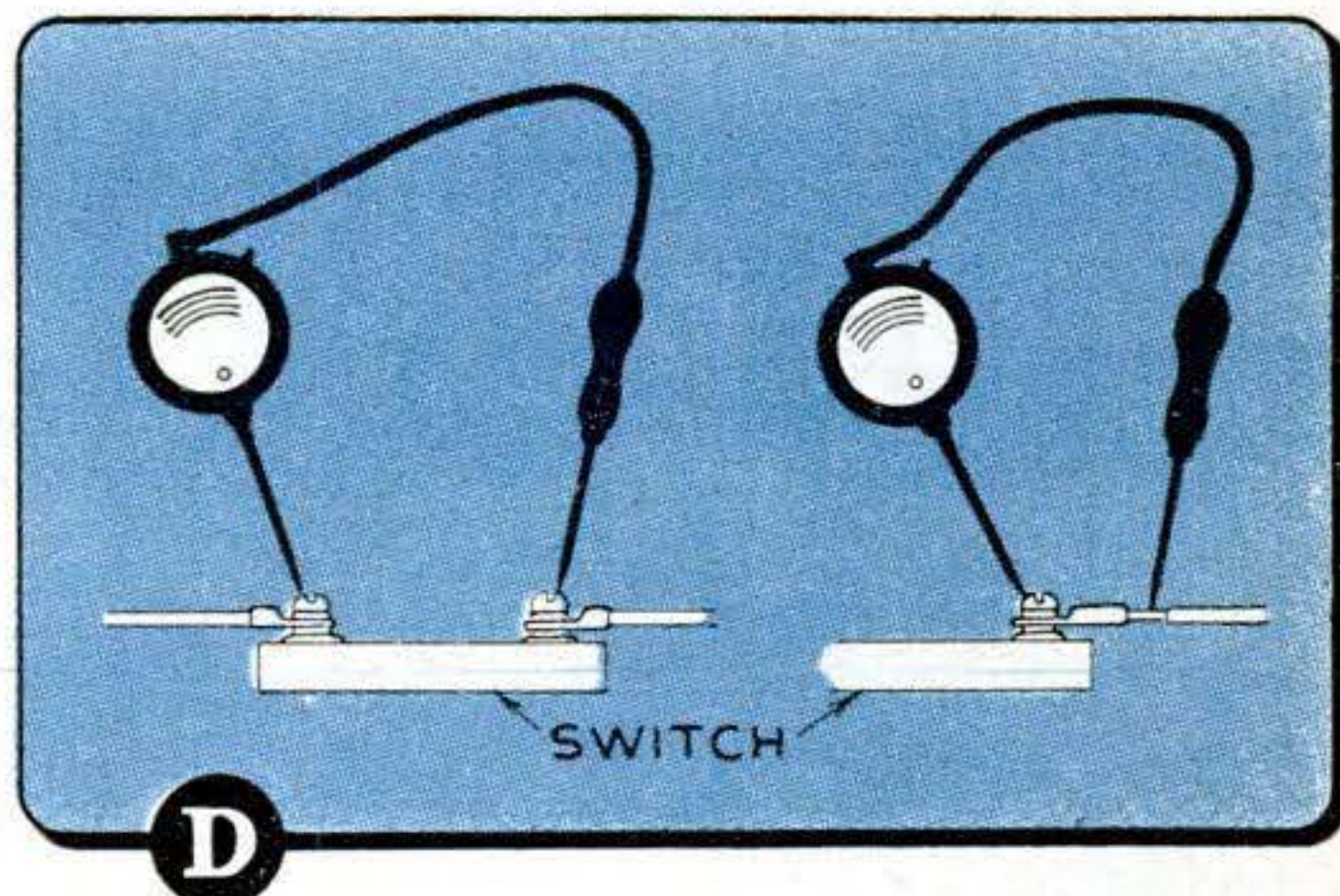
Don't depend on visual inspection in checking for loose connections, corroded terminals, and frayed or partially broken wires. Instead, test the major circuits for total voltage, and if the amount appears insufficient, work back along the circuit until you find the place or places where the voltage drop occurs. If all connections are sound and a serious drop still results, look for either a partially broken



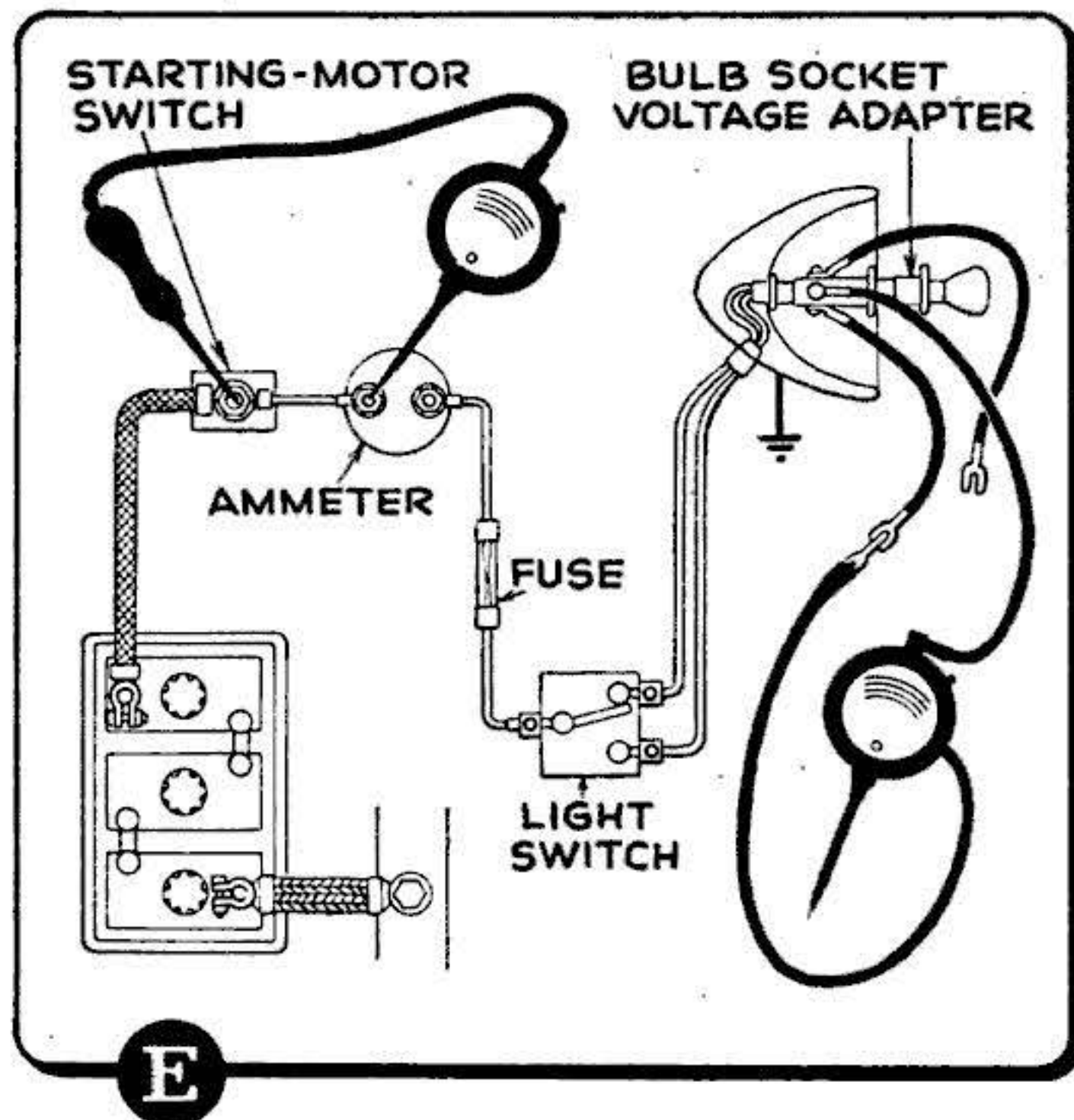
HIDDEN DEFECTS THAT INTERFERE WITH GOOD PERFORMANCE ➡



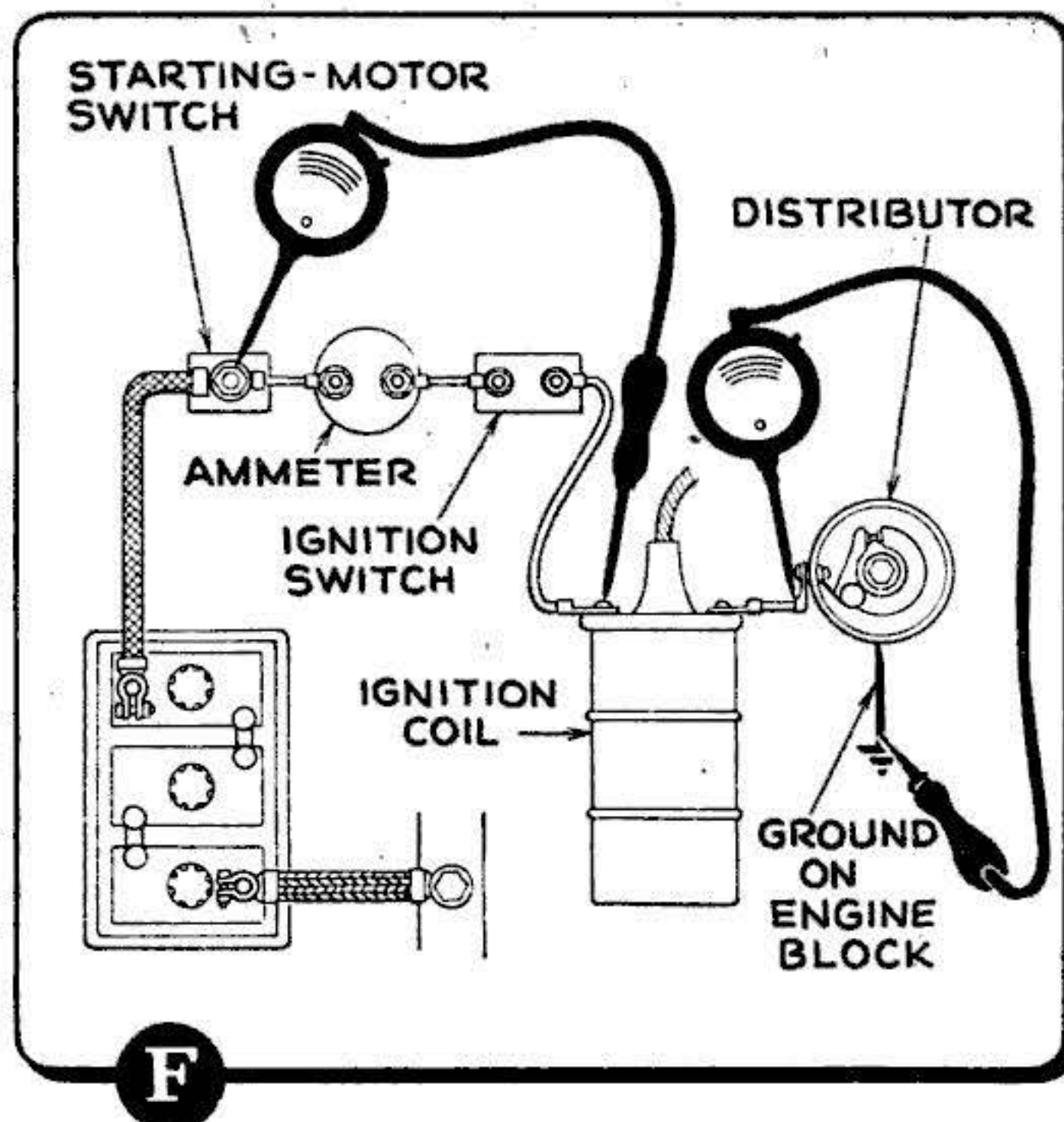
A voltage drop between the starting motor and the ground, although uncommon, can cause poor starter performance. With the starter turning and the low scale in use, the drop must be less than .1 volt



Poor contact within a switch is detected as shown at the left above. Use the low scale and be sure the switch is closed; the drop shouldn't be more than .2 volt. Test each terminal as at the right



Left, the battery-ammeter line is tested; the drop should be under .2 volt. Use a bulb-socket adapter to check headlight voltage with the bulb lighted. The allowable drop varies with candlepower of the bulb. With a 21-c.p. bulb, the reading should be at least 5.6 volts; with a 32-c.p. bulb, 5.4 volts; with a 50-c.p. bulb, 5.1 volts. In a sealed-beam light, make connections directly behind the unit



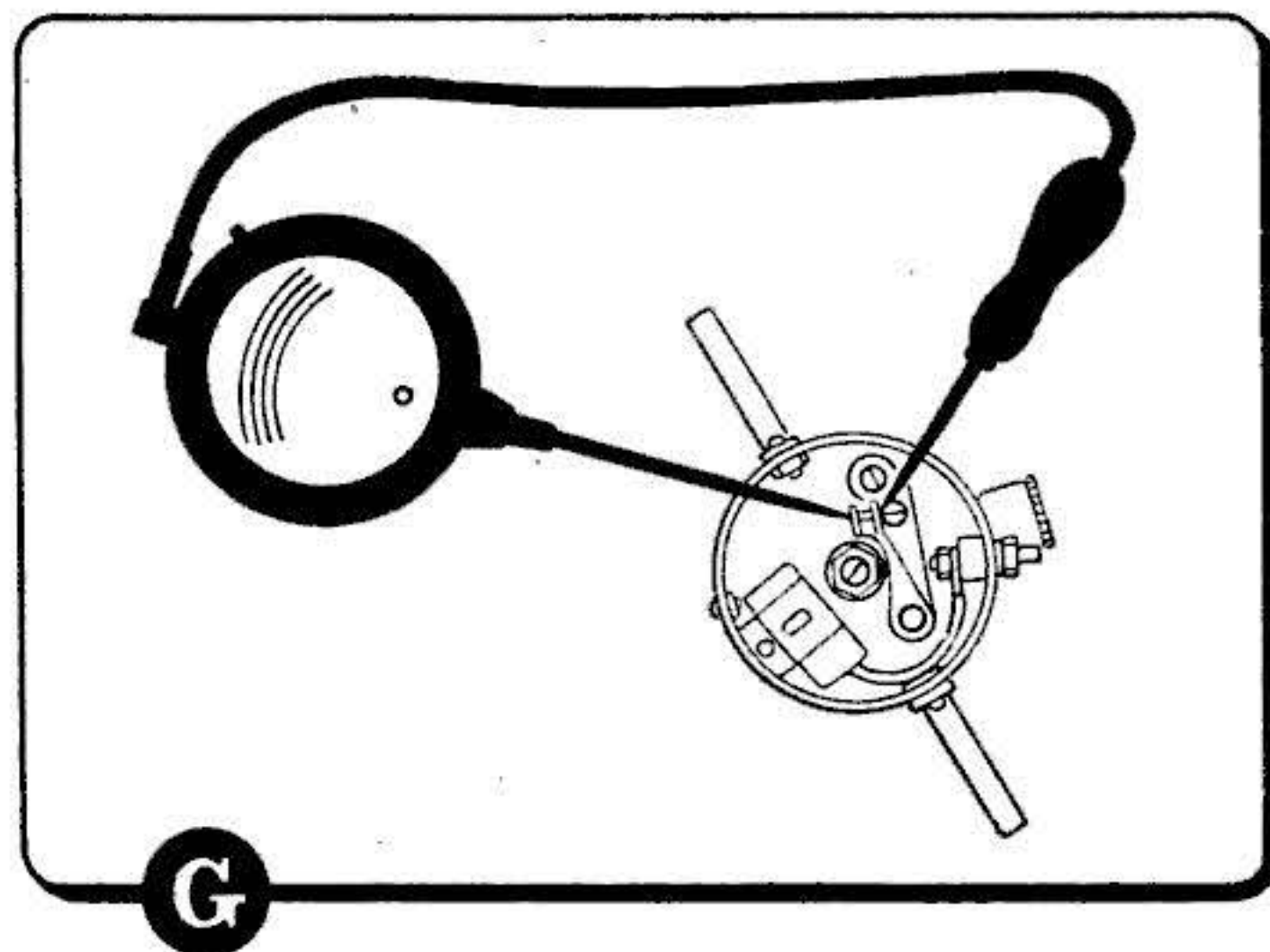
Voltage drop in the primary ignition circuit may be checked by the method shown at the left above. Turn on the ignition and be sure that the points are closed. The low-scale reading should be under .2 volt. To test the total voltage in the primary ignition circuit, use the meter as at the right. If the high-scale reading is 6 volts or more with the ignition on, the circuit is in good condition

wire or one of inadequate carrying capacity.

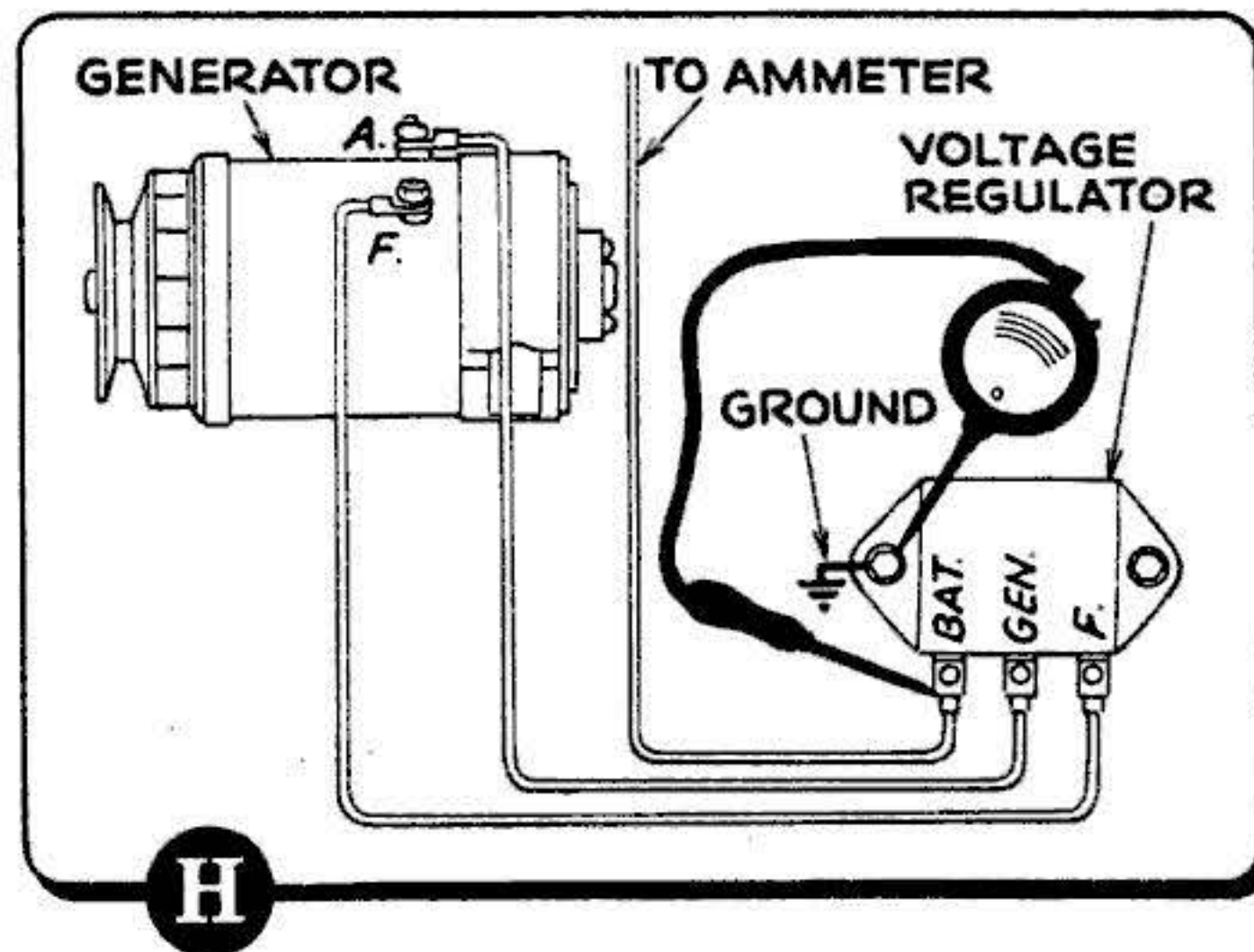
In testing your battery with a voltmeter, check each of the cells individually, as shown in the photo on page 135. The reading for a fully charged battery should be 2 volts or better at each cell. But since the voltage is only a trifle less in a partially discharged battery, it's necessary to place a load on the battery to determine its true condition. Crank the engine with the starter—with the ignition off to prevent it from starting—and repeat the cell tests. If the readings are over 1.7 volts in summer or 1.5 volts in winter, the battery is in good condition. Incidentally, a difference of more than .2 volt between cell readings may mean that

the battery needs recharging or that it has outlived its usefulness. Take the battery out and give it a high-rate discharge test to determine which is the case.

The accompanying drawings show how to check some of the main car circuits. Remember that in checking voltage drop across a switch, the switch must be closed and the current flowing. And don't forget, in testing lighting circuits, that high voltage can cause as much trouble as low. If you do find excessively high voltage, it may be caused by an overcharged battery or an excessive generator charging rate; it may also have its origin in loose connections between the generator, ammeter, and battery.



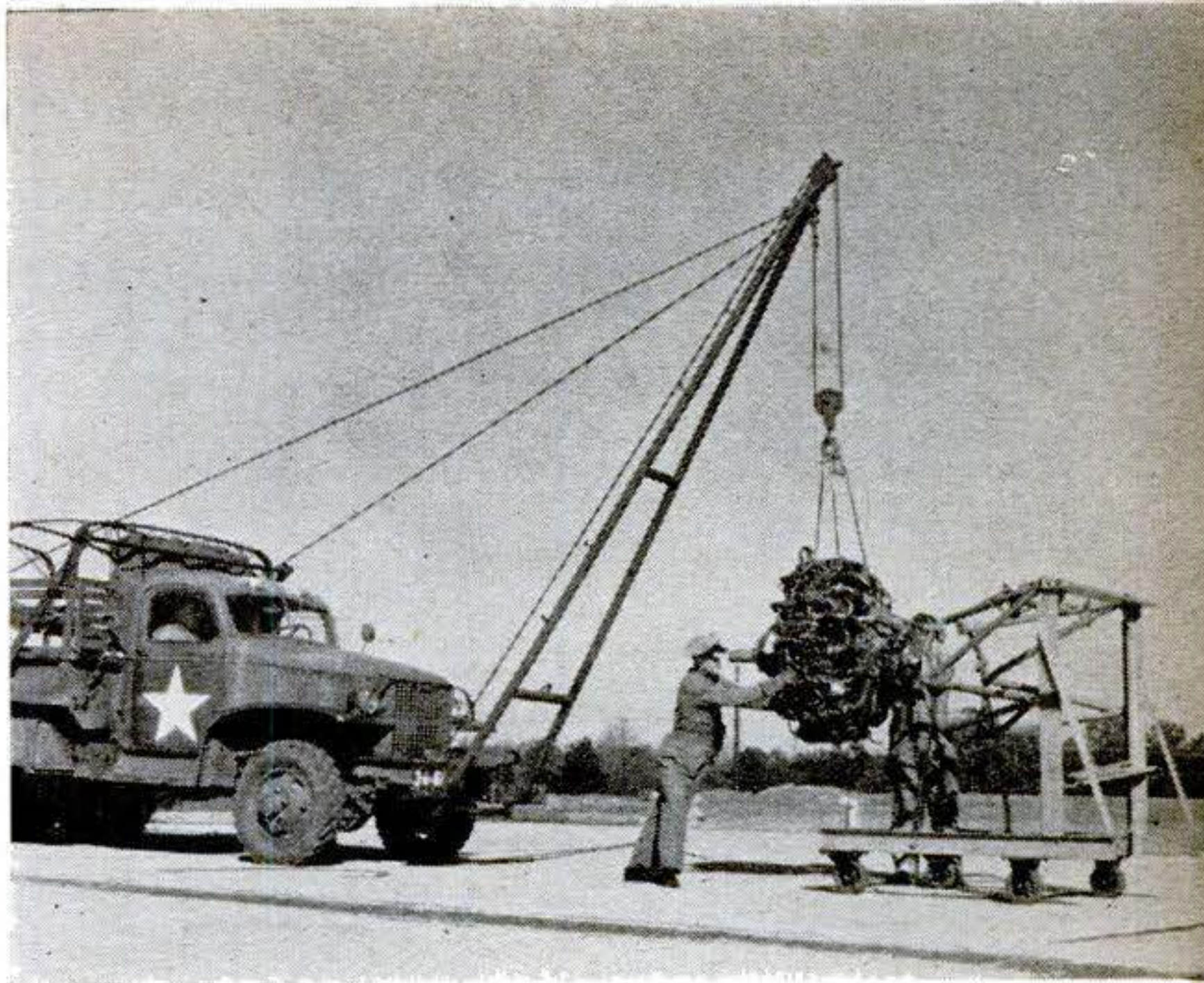
With the distributor points closed and the prods placed as shown, voltage drop between the points may be measured. Turn the ignition on and use the low scale. The reading should not exceed .2 volt



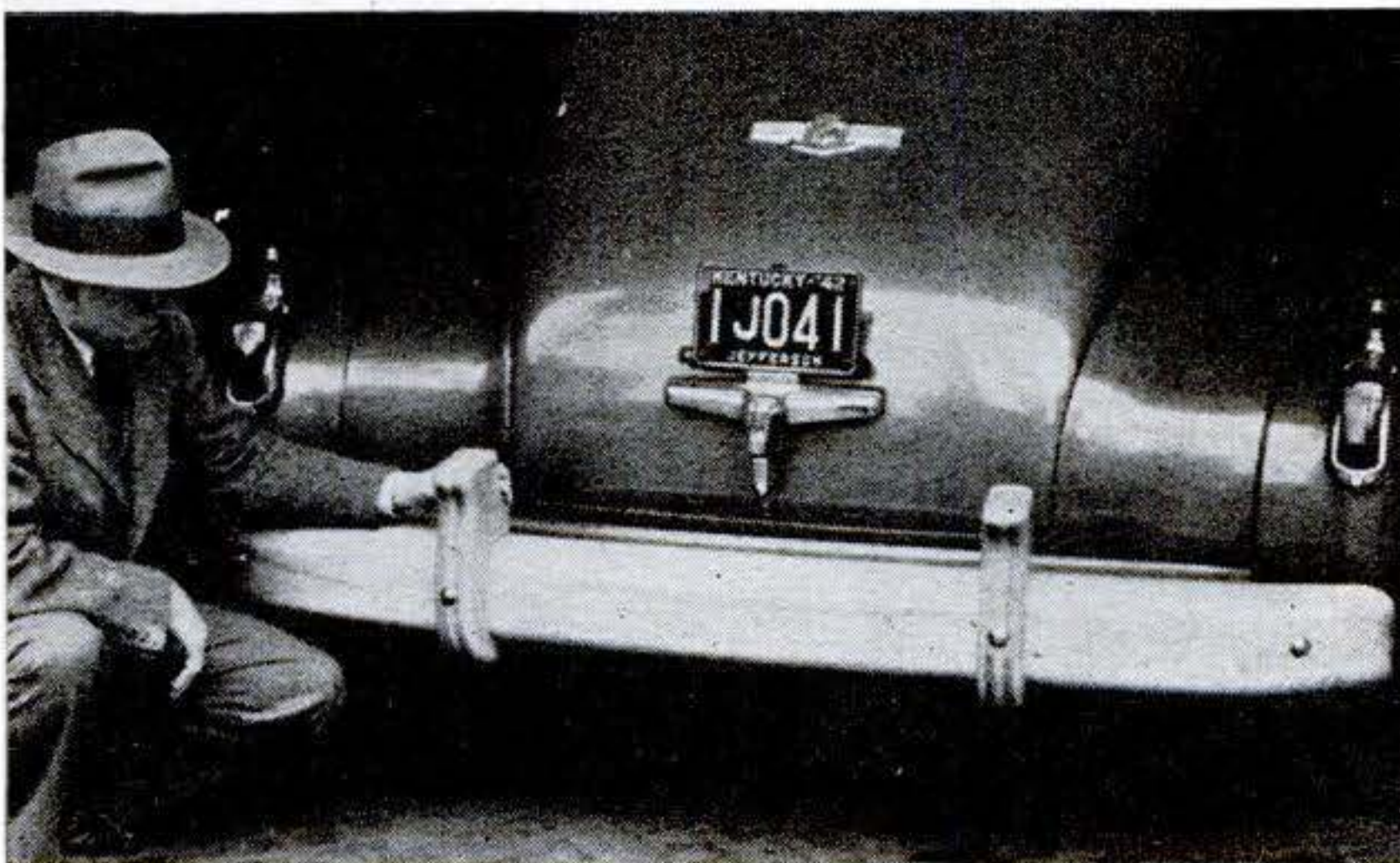
For a voltage-regulator test, run the motor at a fairly fast speed and make sure the regulator is warmed up. If the high-scale reading differs very much from 7.5 volts, adjustment may be called for

AUTO Ideas

A PORTABLE HOIST capable of handling 8,000-lb. planes has been developed for use on 2½-ton Army trucks by Lieut. Col. James H. Reed, Jr., of the Air Corps. Designed for winch-equipped vehicles, the hoist is made principally of two lengths of 3½" iron pipe and a wire cable which anchors it to the truck. The hoist rests on the front bumper, and the cable extends from the apex of the hoist to the rear of the truck, where it is fastened with clamps. Brackets at the side of the truck carry the hoist when it is not in use.



WOODEN BUMPERS made of laminated maple bonded with a resin adhesive, like the one at the left, have been subjected to tests that indicate they will withstand an even greater shock than comparable steel bumpers. As an additional advantage, it is claimed for the wooden bumpers that they can be polished very quickly if scratched. Even chunks chipped out of them can be replaced and the scars hidden beneath a new finish. The weight of the laminated type is slightly less than that of steel bumpers.



THIS CAR-TOP RACK is held securely in place on top of the car by ⅛" by ½" steel clamps that clutch the roof gutters and are drawn taut with turnbuckles attached to ⅛" cables. The cables are passed through screw eyes installed along the inside length of two 1" thick wooden transverse supports. If these supports are made to conform to the contour of the car top, they can be secured firmly with a minimum of tension. Glue felt or some other soft material to the bottom to protect the car finish. The platform is made of 1" by 3" pieces spaced 3" apart. Paint the unit to match the car.—E. W. L.

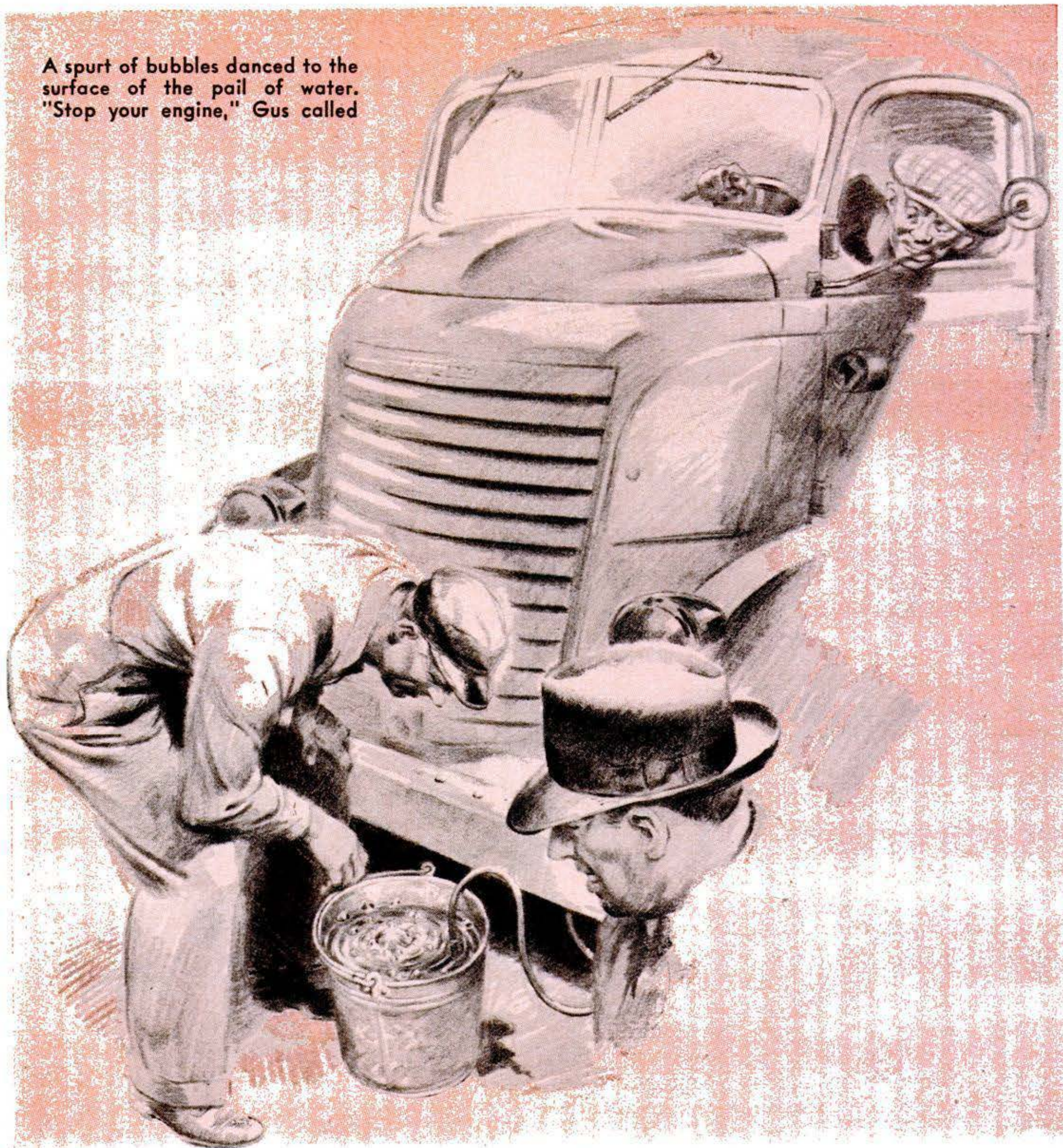


Think-OF AN IDEA!

If you would like to let others know about your pet auto tip—and get paid generously for doing so—just write your idea in 100 words or less, draw rough sketches, and send them to the Automobile Editor, POPULAR SCIENCE MONTHLY, 353 Fourth Avenue, New York 10, N.Y.

ANTIFREEZE SOLUTIONS, used all last winter and saved for re-use this season, can have their rust-inhibiting properties restored by the addition of a chemical inhibitor originally developed for the Army and recently made available to the public. Although the new compound does not contribute to the antifreeze properties, it does neutralize those solutions that have become acid through extended use. When treating a solution, it is advisable also to filter it in order to remove dirt and rust particles which might impair cooling-system efficiency.

A spurt of bubbles danced to the surface of the pail of water. "Stop your engine," Gus called



GUS FINDS TROUBLE IN BUBBLES

By MARTIN BUNN

"MAWNIN', Mistuh Wilson." Gus Wilson looked up from his workbench and saw Peter Jackson, the likeable colored truck driver, standing just inside the doorway of the Model Garage shop.

"Hello, Peter," said Gus. "What's the matter now? Is that old rattletrap of yours acting up again?"

Peter shook his head. "I ain't drivin' that

ol' truck no mo'," he said. "Mistuh Dill, he promoted me to a two-ton."

"That's fine," Gus told him. "Well, what's the matter with your two-ton?"

"There ain't no one know," Peter said gloomily. "That's why Mistuh Dill tole me to bring her over here to you-all. He's a-comin' hisself, sho'tly . . . Here he is now."

John Dill, who has charge of the Johnson and Fredericks trucks, came into the shop.

"How're you doing, Mr. Dill?" Gus greeted him cheerfully.

"Apparently not very well," Dill said grouchily. "We've been having a little difficulty locating some cooling-system trouble in the truck that Peter here drives. I hadn't given up on it by any means, but last night Mr. Fredericks heard about it somehow, and told me I'd better bring the truck over here and ask you to take a look at it . . . Mr. Fredericks is the boss—and it seems like you're the champion trouble shooter of these parts!"

Gus saw why Dill was miffed, and sympathized with him. "Oh, Mr. Fredericks was just acting out of old habit," he said lightly. "You know we used to take care of the Johnson and Fredericks fleet back in the days when it consisted of one truck, and when Fredericks thinks of trouble now, he still thinks of me. I'll check over the job with you, just to satisfy him."

Dill grunted, somewhat mollified. "Well," he said, "two heads are better than one."

Gus nodded diplomatic agreement. "Cooling-system trouble, you said?" he suggested.

"Yes," Dill told him. "Tell Mr. Wilson what happens every morning, Peter."

"It's thisaway, Mistuh Wilson," Peter said. "When I starts mah motor in th' garage in th' mawnin', she runs fine. First job I do ev'ry day is take a load up to th' freight depot. That's only half a mile, but befo' I gets there mah motor's all het up, an' when I stop, a lot of water runs outa th' radiator overflow pipe. After that mah motor gets hotter'n hot, an' befo' long I gotta put a li'l mo' water in th' radiator. An' then I gotta keep on puttin' a l'l' mo' water in it ev'ry couple of hours all day long."

"That darned truck," Dill said, "is wasting two gallons of antifreeze a week. Drive it in, Peter."

As Peter drove the truck into the shop, Gus's educated ears told him that its engine wasn't running quite perfectly. He took off the radiator cap. "No sign of overheating now," he remarked.

"No, suh, Mistuh Wilson," Peter said. "I ain't been up to th' freight depot yet—that's why!"

"Nonsense!" Dill snapped. "What could going to the freight depot have to do with your engine overheating?"

"Mebbe," Peter said fearfully, "dat freight depot's got a hoodoo on me!"

"Nonsense!" Dill said again. "Well, Mr. Wilson—any bright ideas?"

"Not a one, so far," Gus confessed cheerily. "In a case of overheating, the first things I always check for are late ig-

nition timing and too lean a fuel mixture, but I suppose—"

"You suppose dead right," Dill assured him, rather unpleasantly. "The first thing I checked was the ignition timing, and the second thing was the carburetor adjustment. They're both O. K."

Gus nodded. "Then there's the radiator core," he suggested. "When the coolant runs out of the overflow pipe, it's often an indication that there's a stoppage of circulation somewhere between the upper tank of the radiator and the intake of the water pump. Usually it's caused by the radiator core being stopped up."

Dill sneered. "That radiator's as clean as it was the day this truck left the factory. I had it checked as soon as this overheating showed up, and I had the core thoroughly flushed out. The radiator's O. K., I tell you—I'll bet you anything you like!"

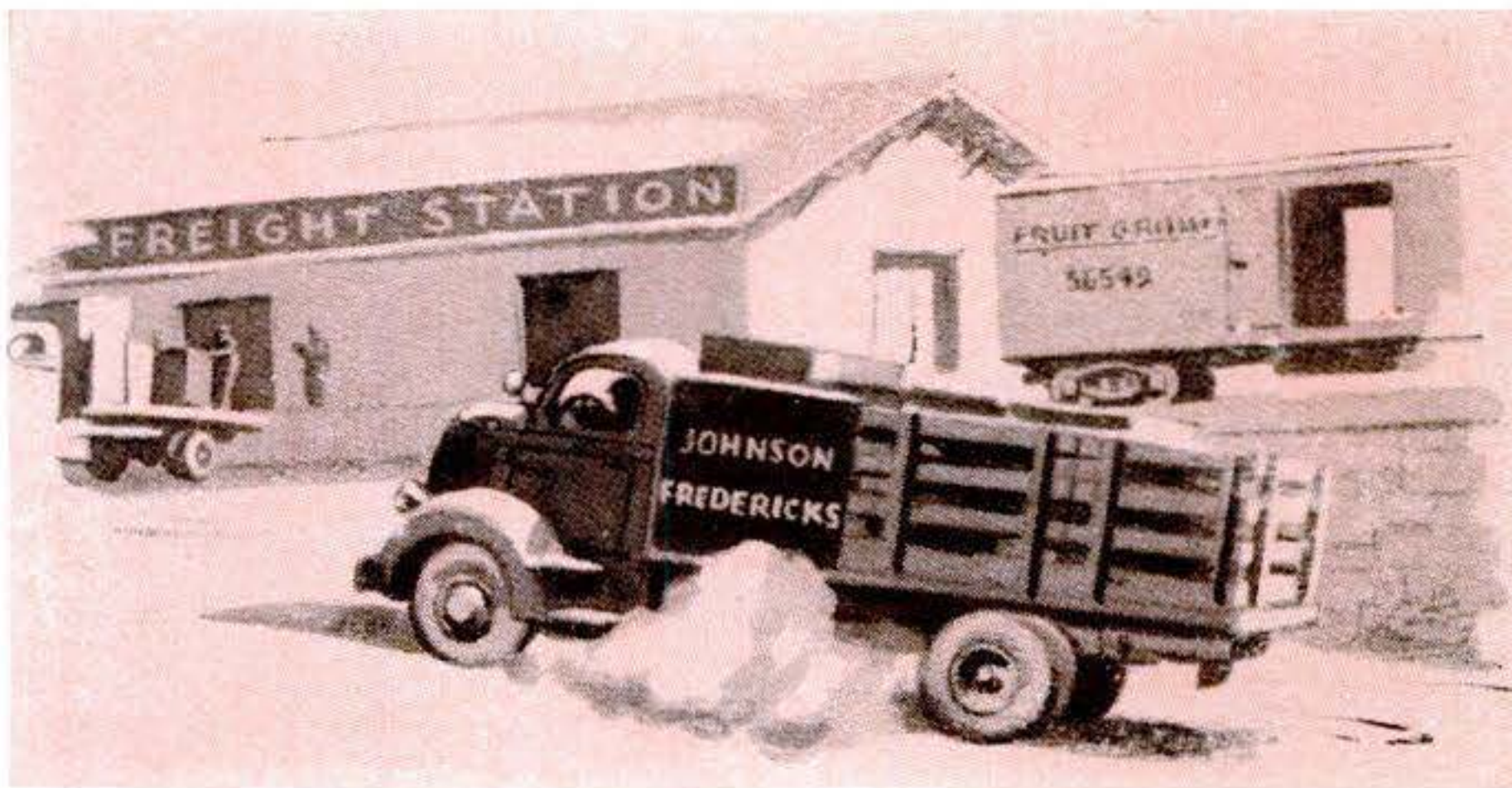
Gus grinned. "I'm a poor gambler—I never bet unless I'm certain," he said. "Well, let's see, now . . . How about the thermostat? Sometimes that little bleeder hole—the one that lets the air out when you're filling the cooling system while the valve is closed—gets clogged up. When that happens, pressure from the heated water builds up behind the thermostat until all of a sudden the hot water acts on it, the valve pops wide open, and the coolant gushes up through the radiator and out of the overflow pipe."

Dill let Gus finish. Then he said: "That's real interesting, Mr. Wilson. It might happen, of course—but it didn't happen with *this* truck, because we put in a new thermostat when we first had trouble, and it didn't do a bit of good."

"Peter," said Gus, "switch on your engine again, will you?"

Peter climbed into the cab, switched on the ignition, stepped on the starter, and allowed the engine to idle. Gus listened intently for a few seconds, shook his head in a disappointed way, and signaled Peter to stop the engine.

"It doesn't sound the way it did when he



drove the truck into the shop," he said, more to himself than to Dill. He scratched his left ear as he did a half minute of hard thinking. Then he said to Peter: "How does your truck act when you've got a full load on it, or when you're pulling up a hill? Has your truck got plenty of power?"

Peter shook his head. "No, suh, Mistuh Wilson, she ain't got th' pep what a fine bang-up truck like this here one ought to have. I done told Mistuh Dill that, but he says there ain't nothin' at all th' matter with the way she pulls."

"Just imagination!" Dill said angrily. He turned to Gus. "You were listening to the engine a minute ago. Did you ever hear a truck engine run any smoother?"

"I never heard one *idle* any smoother," Gus said. He raised his voice and called: "Hey, Stan!"

Stan Hicks, the grease monkey, emerged from the stockroom.

"Jack up the rear wheels of this truck, will you?" Gus said. Then he went over to his workbench and reached down a short length of rubber tubing from the shelf above it.

"She's jacked up, boss," Stan reported.

"O.K.," Gus said. "Now get me a pail of water."

Stan brought him a pail of water. Gus set it on the floor near the front end of the truck. Then he carefully worked one end of the tubing over the lower end of the radiator overflow pipe on the truck and submerged the other end of the tubing in the pail.

"Start your engine," Peter," he directed. Peter climbed back into the cab and restarted the engine. Gus was staring at the water in the pail. "Let her idle," he said. "Now put her into gear."

The truck's rear wheels began to revolve. Dill stepped over beside Gus and also stared at the water in the pail. "What's all this?" he demanded. "Nothing's happening."

"Something is going to happen in a moment," Gus told him. "Keep your eyes on the end of that tube and you'll see it . . . Now, Peter, give her a little more gas. That's it. Now, when I tell you to, put on your brakes—not hard enough to kill your engine, but hard enough to make it work the way it has to when you've got a full load and you're pulling up that hill to the freight depot. Understand? O.K.—put 'em on!"

Peter applied the brakes, lightly at first, then harder. The engine labored against their drag. A spurt of bubbles danced to the surface of the water in the pail. Gus could not conceal his satisfaction as he waved to the truck driver.

"Stop your engine!" Gus called. Then he turned to Dill. "Get it?" he asked.

"I saw some air bubbles," Dill growled. "What do you make of it?"

"When air gets into a cooling system," Gus explained, "it displaces some of the cooling fluid, which runs out through the overflow pipe. Those bubbles in the pail prove that it is air in the cooling system that has been causing the loss of coolant, and making the engine overheat."

Dill stared at him. "Maybe you're right," he said grudgingly. "But if you *are* right, how is the air getting into the cooling system?"

Gus motioned toward the pail. "Our little test answers that question," he said. "Those bubbles coming in a spurt show that the air is coming from one of the cylinders—a compression leak. If the bubbles had come to the surface slowly and in a steady stream, they would have shown that the air was getting into the cooling system by way of the water-pump shaft or around a hose. When they come in a spurt, it's certain proof of a compression leak. The chances are a hundred to one that you'll find a leaky head gasket causing the trouble."

Dill did some more thinking. Finally he said: "I still don't get it. Why didn't the bubbles appear until Peter put on his brakes?"

"It often happens," Gus told him, "that a head gasket doesn't leak until the engine is under load or pulling up a grade. When Peter drove the truck into the shop, my ears told me that one of the cylinders wasn't acting just right, and he gave me another clue when he said that the trouble didn't show up until he'd taken a load up to the freight depot. Applying the brakes against the engine, with the rear wheels jacked up, had the same effect on the head gasket that a full load on the road or pulling up a hill would have."

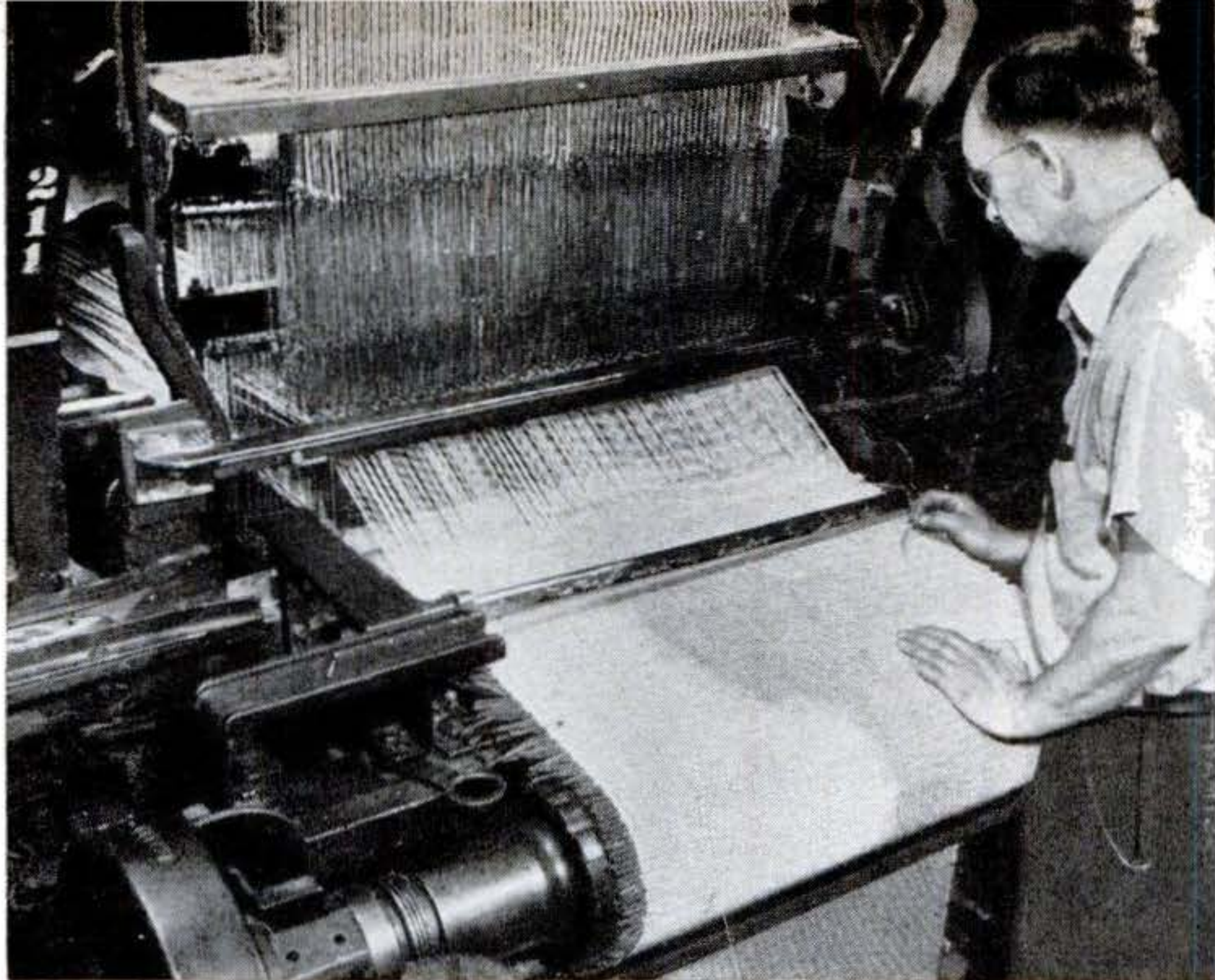
"Well," Dill said ungraciously, "we'll see. I'll get in touch with you later."

THAT afternoon Joe Clark called Gus to the office telephone. "This is Dill," the voice at the other end of the line said. "You were right—it was a leaky head gasket. You're a champ trouble shooter—I'll give you that!"

"Oh, I was just lucky—stumbled over it," Gus said modestly. "Dinner some night? . . . I'd be glad to . . . O.K. So long."

He replaced the receiver and turned to his partner. "Dill's stopped being sore at me," he said. "'A soft answer turneth away wrath'—who said that, Shakespeare or the Bible?"

"I wouldn't know," Joe said. "But don't you let an invite to dinner turn you away from making out a time slip for every minute on that job!"



Only minor mechanical modifications are required to convert a standard carpet loom for making the retread

NEW TIRE RETREADS ARE WOVEN ON A CARPET LOOM

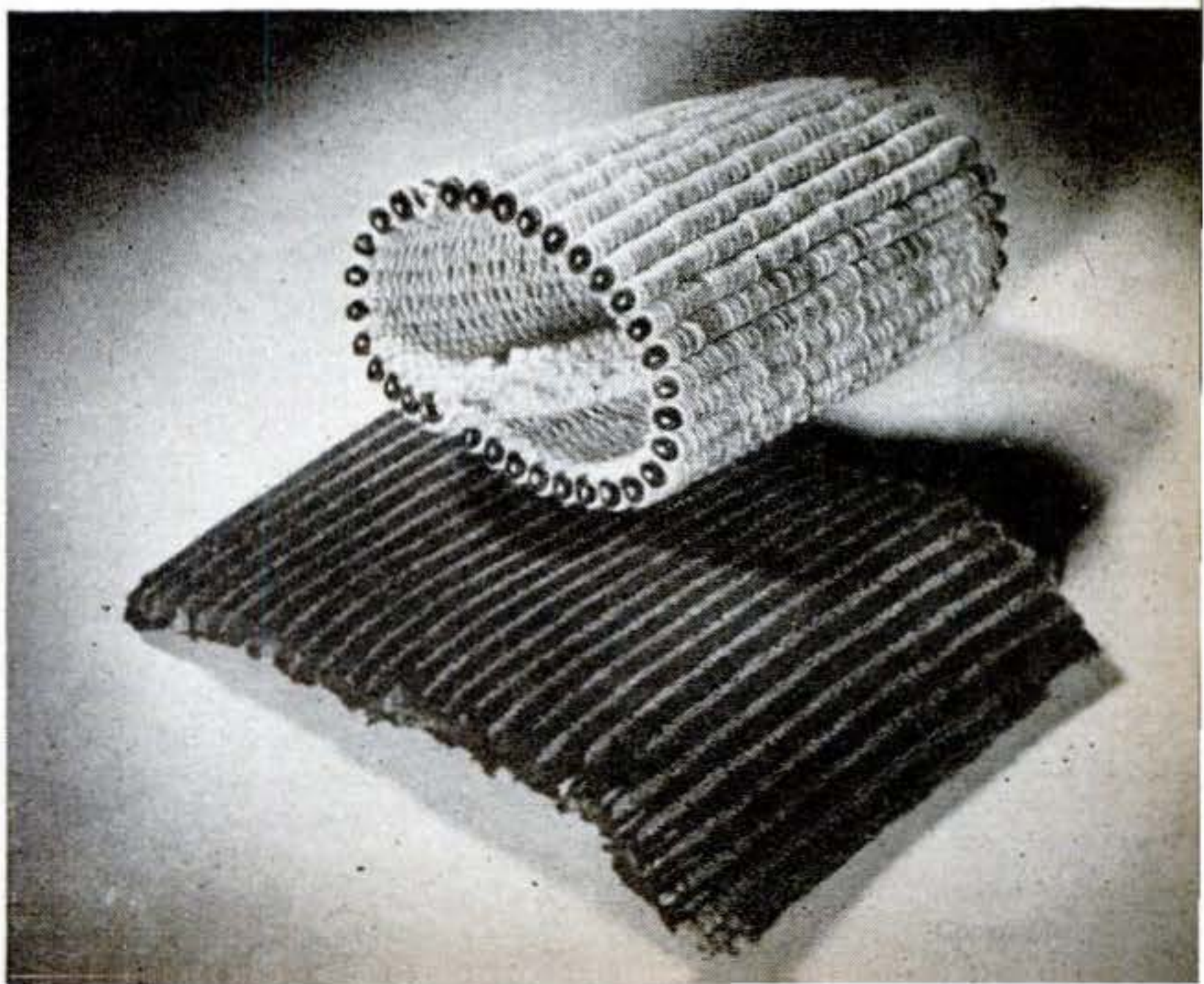
A TIRE retread of cotton and rubber woven together on a carpet loom holds promise of materially increasing the mileage to be secured from the national stockpile of reclaimed rubber. Road tests reveal that the carpet-type retread gives about 75 percent of the mileage given by a retread containing rubber alone, and needs but 40 percent as much rubber to do it. Thus while a standard retread ran 1,080 miles for each pound of reclaim, the carpet-fabric retread lasted 1,900 miles per pound.

Developed by the Alexander Smith & Sons Carpet Company, Yonkers, N. Y., the fabric is composed of lengths of rubber, extruded around a cotton cord by the same kind of machine used for insulating wire, and then woven with cotton cords. The result resembles an uncut pile carpet. A standard Jacquard loom is used, modified slightly to handle the springy extrude.

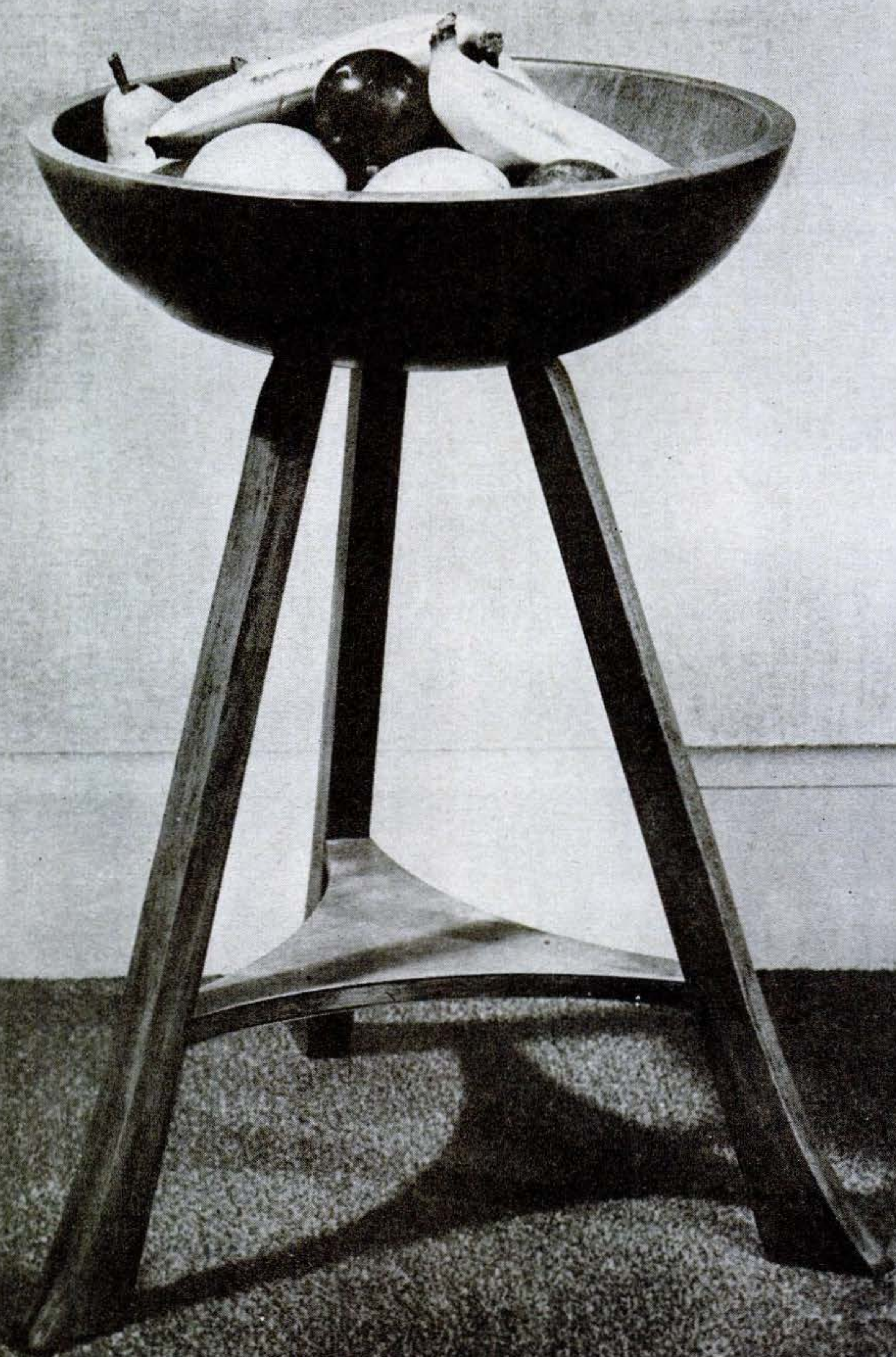
The fabric is applied to a tire carcass in the same manner as the camelback or thick strip of rubber used to give body to an ordinary retread; it is cemented in place, covered by a strip of cushioning rubber, and the whole tire is then vulcanized until the cords are thoroughly impregnated with rubber. In the course of tire wear, the ends of the yarn are worn through, leaving an antiskid surface. As with other retreads, speeds higher than 35 m.p.h. are not recommended with these tires.



The carpet-pile fabric is vulcanized to a tire in the same way as an ordinary retread. Below is the fabric before and after thousands of miles of use. The worn ends of the cotton yarns reduce skidding



HOME AND WORKSHOP



GRACEFUL THREE-LEGGED *Utility Stand* IS BUILT FROM A CHOPPING BOWL

By JOSEPH ARONSON

GIVEN an ordinary 12" to 13" round wooden chopping bowl, all you need to make this novel stand in the Early American style is three 19" pieces of $\frac{7}{8}$ " by 2" hardwood for legs and one piece about $8\frac{1}{2}$ " by 10" for the lower plate. The result is a satisfying bit of furniture, useful in almost any room as a sewing stand, as a receptacle for fruits and nuts, or as a general catchall for the usual run of odds and ends.

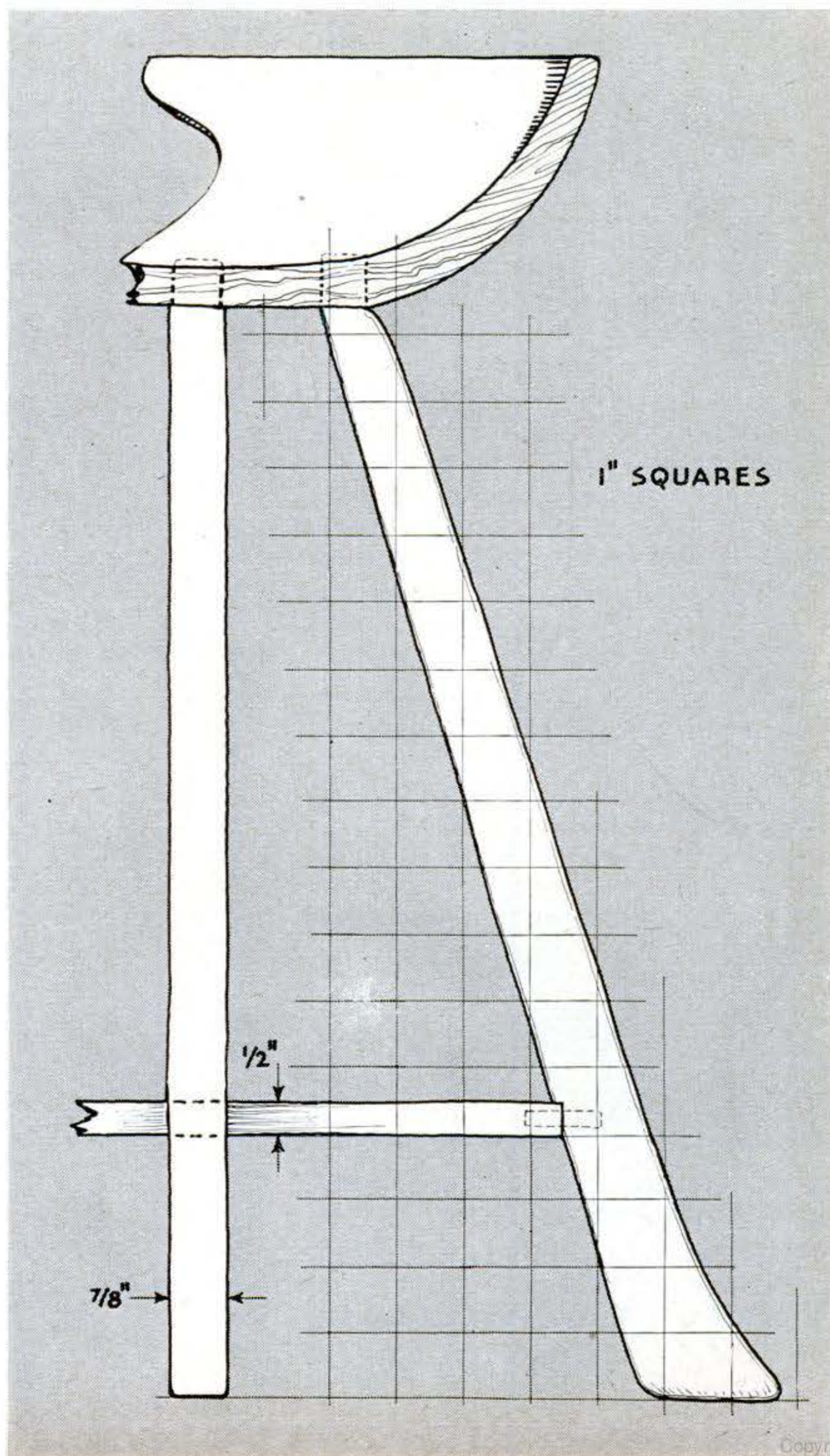
Saw out the legs to the profile shown in the drawing and round all edges fully as indicated in the photograph on the facing page. Note particularly that the end of the leg that dowels into the bowl is *not* a continuation of the rake of the leg, but is a true vertical. This makes it easier to locate the holes in the bowl. Saw the peg ends of the legs square and reduce the corners with a rasp until the pegs have been made as round as possible. Be sure to gauge carefully and frequently to the $\frac{5}{8}$ " bit you will use for boring or, better yet, bore a $\frac{5}{8}$ " hole in a trial block and use this as a gauge as you proceed with the rasping.

Make a paper pattern for the lower plate, drawing a circle with an 11" radius and locating three equidistant points on the circumference from each of which an arc is drawn at a radius of $9\frac{1}{8}$ ". Saw the plate section out of the $8\frac{1}{2}$ " by 10" hardwood stock and notch it into the legs about 4" up from the feet; then secure each joint with a dowel and glue.

Locate the holes in the bowl by setting it on the frame and marking them, and bore vertically from the bottom. Press the pegs in as far as they will go, sanding them off smoothly on the inside. If you have any doubts about the snugness of the fit, small hardwood wedges

$\frac{1}{8}$ " thick and $\frac{1}{2}$ " long can be driven in across the grain to take up any looseness in the joint.

In finishing it will be necessary first to remove the wax that is usually found on these bowls by using benzine or naphtha, but be careful of fire. Then darken the wood to your taste with oak or walnut stain, apply a thin coat of shellac, and sand and wax to the desired smoothness.



Novel Wall



By **WALTER E. BURTON**

NICE balance of proportion combined with practical utility is incorporated in this novel wall cabinet having three hinge-like, swinging drawers. Except for a few brads and screws, the entire cabinet is made of wood. The three drawers pivot around a wooden pin made of a $\frac{1}{2}$ " maple dowel. When closed, the drawers nest in a housing of $\frac{1}{4}$ " stock, and the front, back, and the left side of each drawer are also made of $\frac{1}{4}$ " material. The right-hand side of each drawer is closed by the blocks that form the hinge mechanism.

The three-drawer assembly is built as one unit and then sawed into sections to form the individual drawers, thus assuring uni-

formity of size and fit. Enough white pine blocks of any convenient thickness to add up to a little more than 6" are rough cut to shape as shown in the drawing, and $\frac{1}{2}$ " holes are bored through their centers to receive the hinge pin. Align the blocks on a length of $\frac{1}{2}$ " dowel, applying a thin coat of glue to both facing surfaces as they are put on, clamp them firmly, and then remove the dowel. When the glue has set, smooth and square up the piece and cut rabbets to receive the front and back panels of the drawer unit.

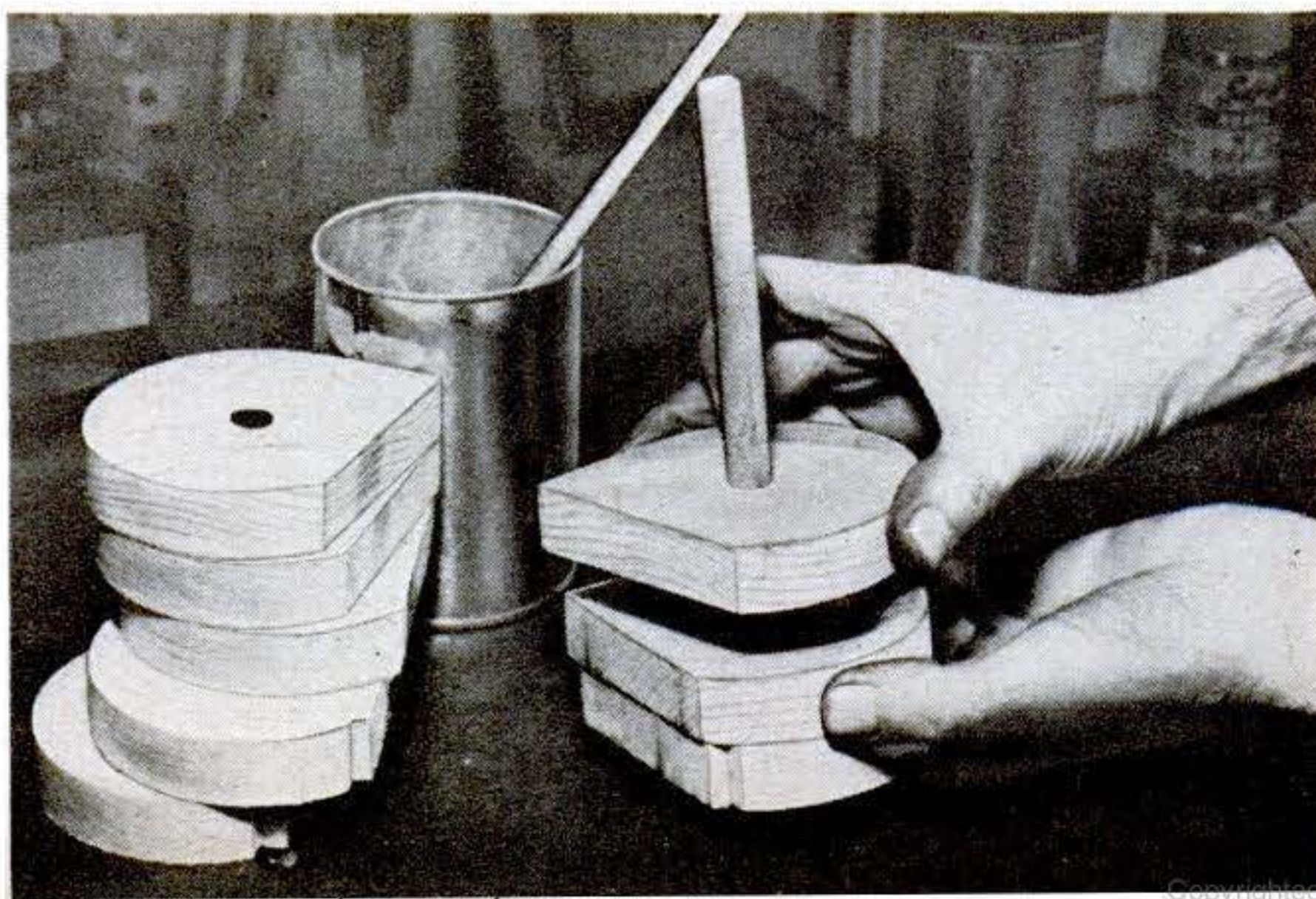
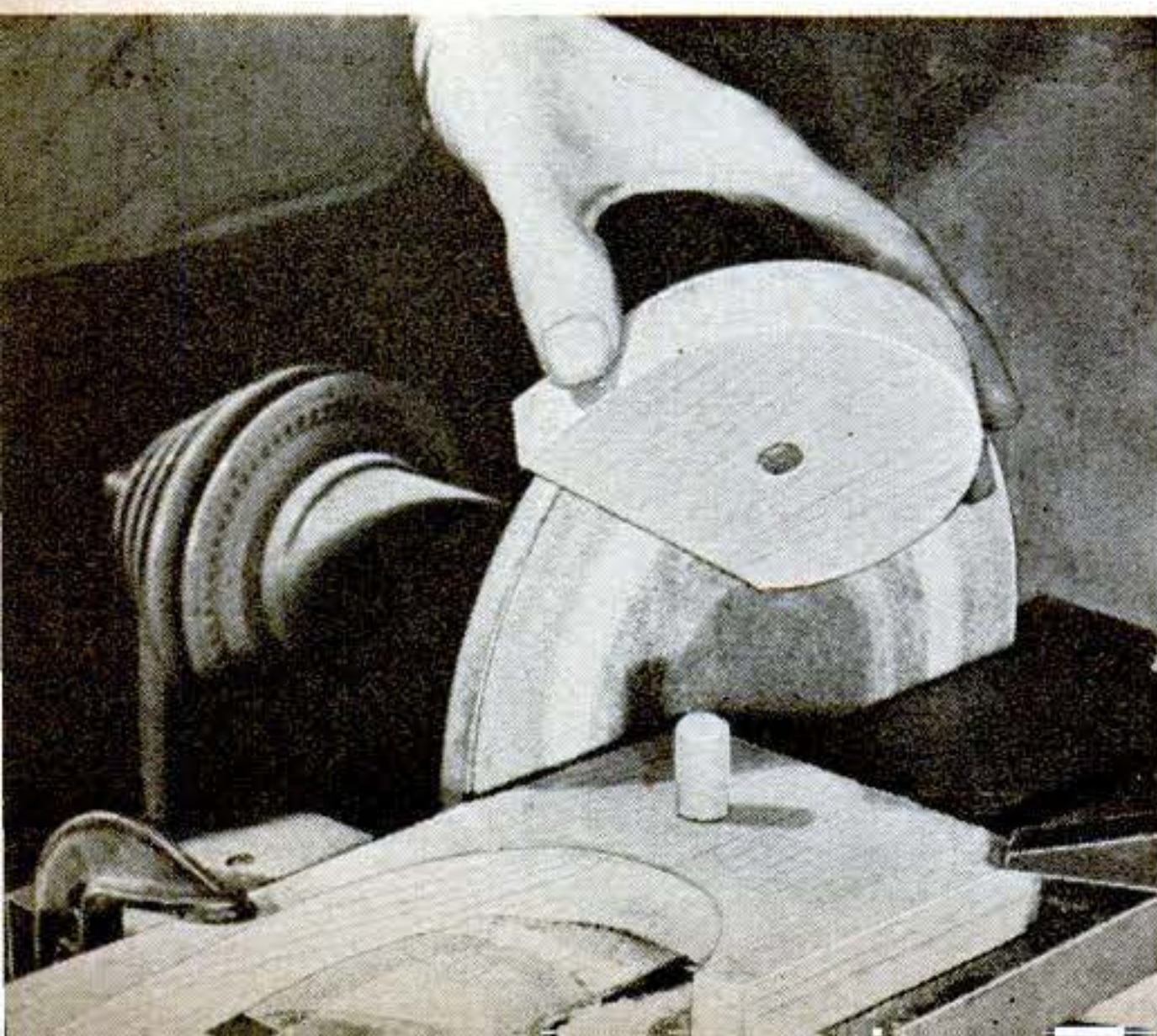
Assemble the front, back, side, and hinge block with brads and glue to form a hollow rectangle which is then bandsawed into three equal parts. Be careful not to place brads where the saw will meet them. Next glue the $\frac{1}{8}$ " bottoms inside the drawers, thus completing those units.

The top and bottom pieces of the housing unit have the same shape as a horizontal section of a drawer except that each is made $\frac{1}{4}$ " wider in order to accommodate the back piece of $\frac{1}{4}$ " plywood, which has three countersunk screw holes in it for fastening the cabinet to the wall. Glue and screw a 1" disk to the top end of the $\frac{1}{2}$ " maple dowel upon which the drawers swing. The bottom end has a $\frac{1}{4}$ " disk held by a screw that can be tightened or loosened to regulate the friction between drawers, which should swing easily yet remain in whatever position they are left. A latch or other fastening device is not needed.

Give the cabinet a finish to harmonize with its surroundings. The one in the photo has a black-enameled top and bottom, buff drawer fronts, and a Chinese red interior.

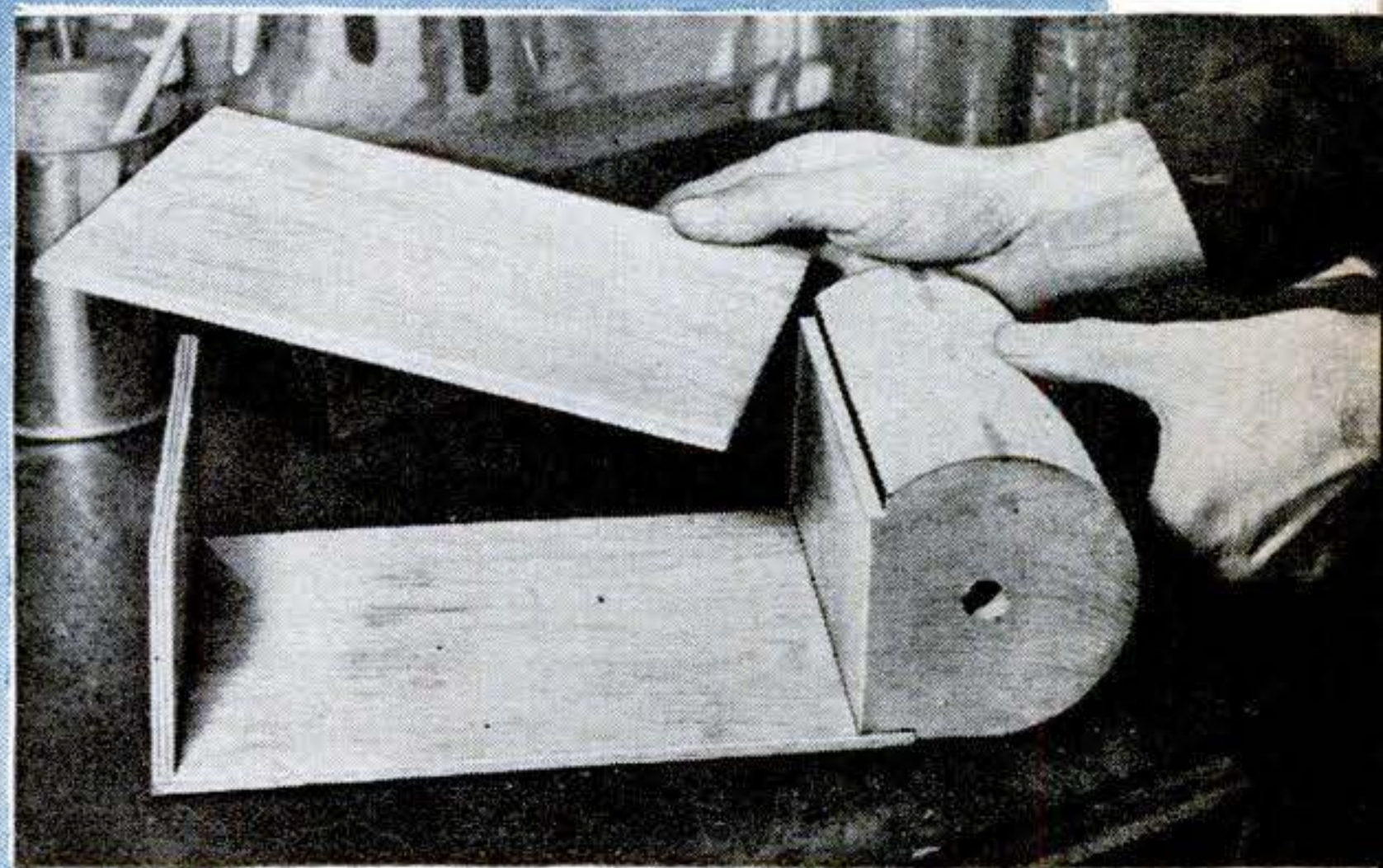
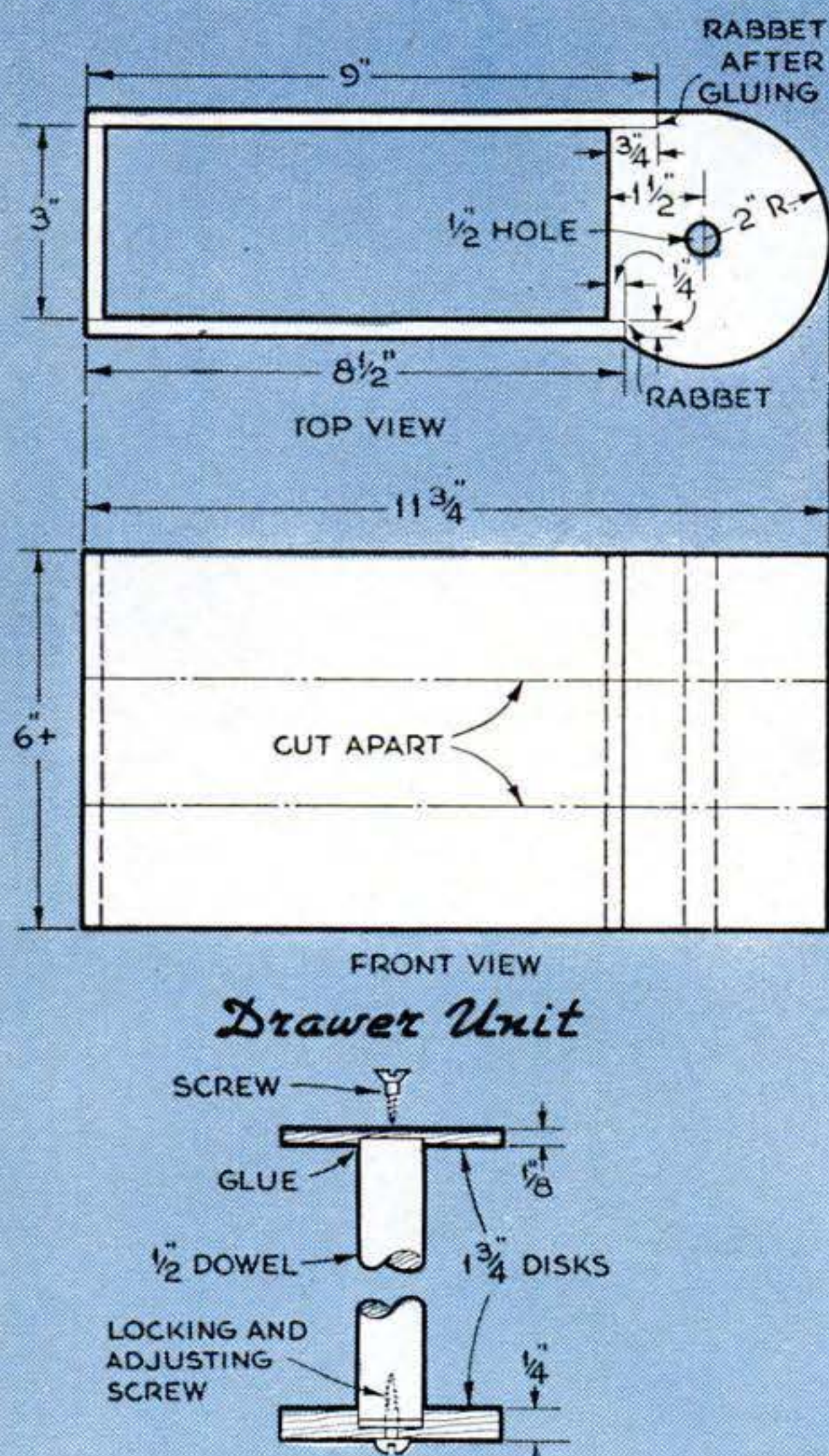
A dowel and a piece of waste stock form a jig that allows of sanding all the drawer blocks to precisely the same curvature

When gluing the blocks into a single hinge unit, stack them on a $\frac{1}{2}$ " dowel for alignment. The dowel is taken out after the blocks are securely clamped

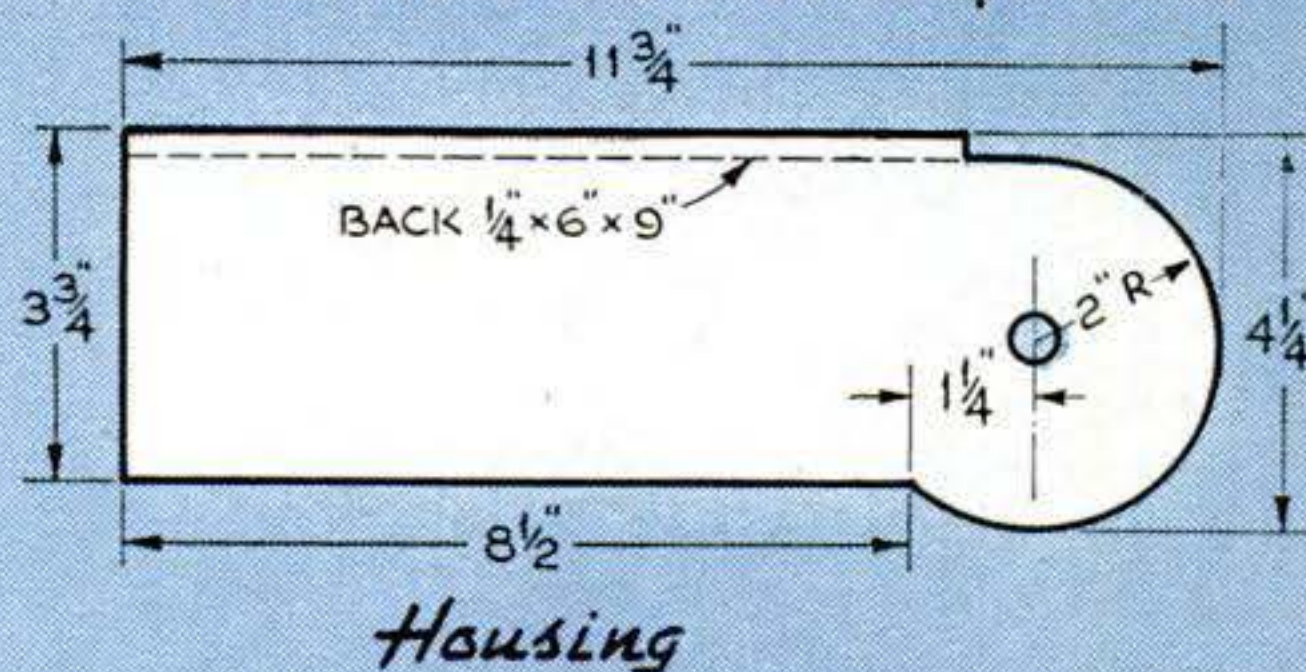


Cabinet

HAS SWINGING DRAWERS



Front and back panels for drawers are glued and bradded into rabbets in the hinge block. This whole assembly is then sawed into three compartments

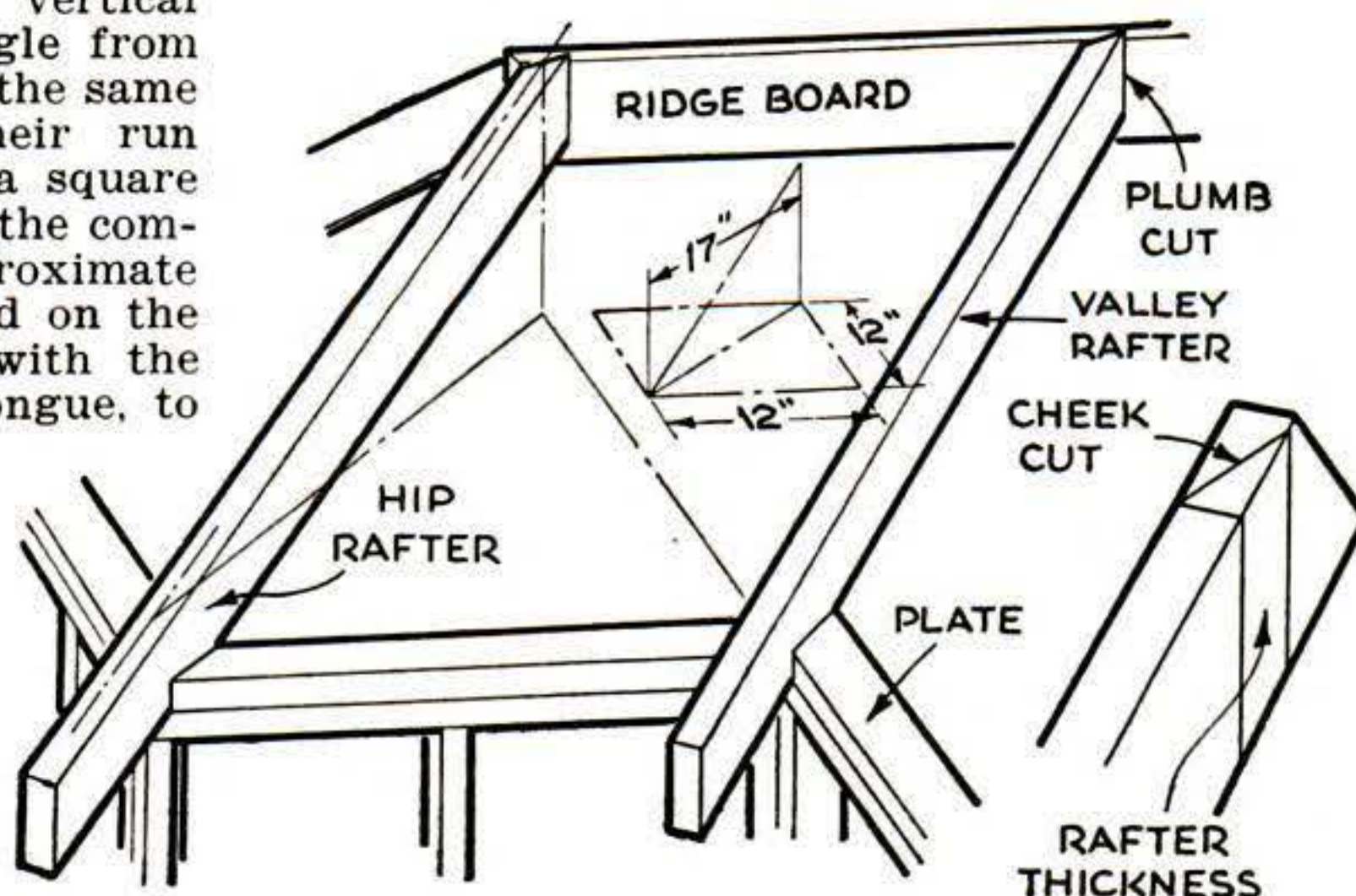


HIP AND VALLEY RAFTERS

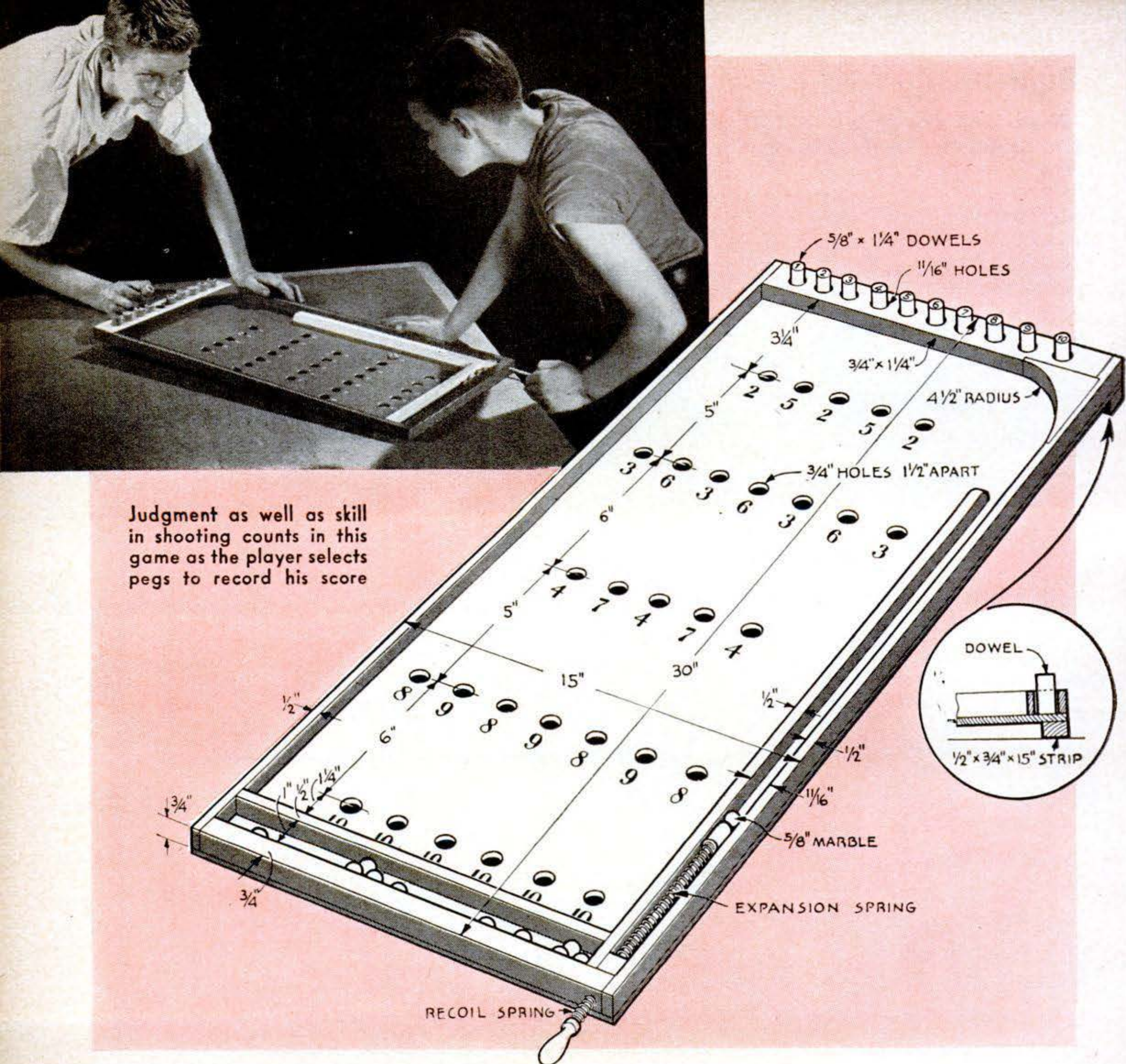
[SHIPSHAPE HOME]

Hip and valley rafters lie in vertical planes that are at a 45-deg. angle from the walls, and while they rise to the same height as common rafters, their run (horizontal) is the diagonal of a square having sides equal to the run of the common rafters. Thus 17" (the approximate diagonal of a 12" square) is used on the blade of a steel square, along with the rise in inches per foot on the tongue, to mark off the angle of the plumb cut and that of the heel cut in the notch.

For the cheek cut fitting against the ridge board, draw a line parallel to the plumb cut at a distance equal to the thickness of the rafter, square across the crown, and draw the diagonal, as shown.



POPULAR SCIENCE MONTHLY SHOP DATA



Pinball Game Scored in Reverse

By MYRON FLEISHMAN

LOW score wins in this pinball game with an upside-down scoring arrangement. The trick is to shoot marbles around the game board so that they fall into the high-numbered holes, whereupon correspondingly numbered dowels are turned upside down in a row of holes provided for them at one end of the board. At the conclusion of ten shots, a player adds up the value of his dowels still remaining upright. A low total indicates, of course, that good marksmanship guided the marbles to the more valuable holes.

The board is constructed mostly of 1/2" by 3/4" wooden strips and of cardboard. Cut the ten dowels from 3/4" stock, and use ten

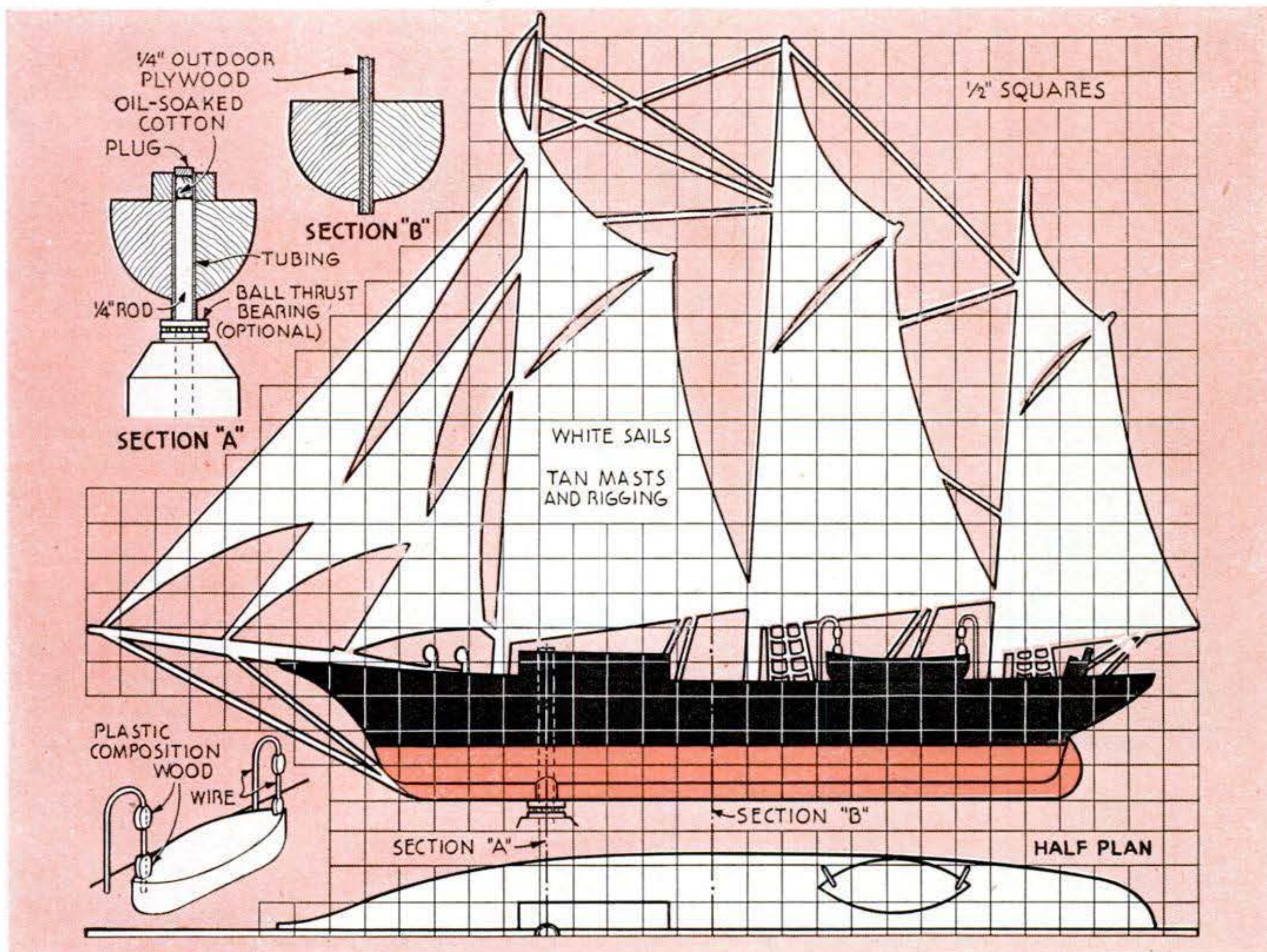
5/8" marbles. The holes in the cardboard can be punched with the end of a piece of pipe ground down to a cutting edge.

Before a player takes his turn at the shooting ram, the ten dowels are arranged in numerical order in their holes. Then a marble is shot with enough speed to make it rebound among the scoring holes. If it falls into a No. 5 hole, for example, either the No. 5 dowel is turned upside down, or the same is done with any combination of dowels the value of which equals 5, and so on for the ten shots. But if a player hits a hole for which no dowel or combination is still available, he forfeits the remainder of his shots. Thus a premium is placed upon the player's shrewdness in turning down dowels.

Built-Up Hull Adds Realism to Rakish Schooner Weather Vane

MORE than a mere silhouette is this weather vane in the form of a rakish schooner, for a three-dimensional effect is achieved by the two quarter-round pieces which form the hull, the deckhouse, and the lifeboats with davits. The central section of $\frac{1}{4}$ " outdoor plywood includes sails, rigging, and the portion of the hull clamped between the cheek-

pieces. It is pivoted on a bar set in a section of tubing, and the ball-and-thrust bearing, if kept lubricated with oil-soaked cotton, will enable the ship to head into any breeze, however light. Paint the hull black above the water line and red below, the sails white, rigging and deckhouse brown, and the lifeboats white.—HI SIBLEY.

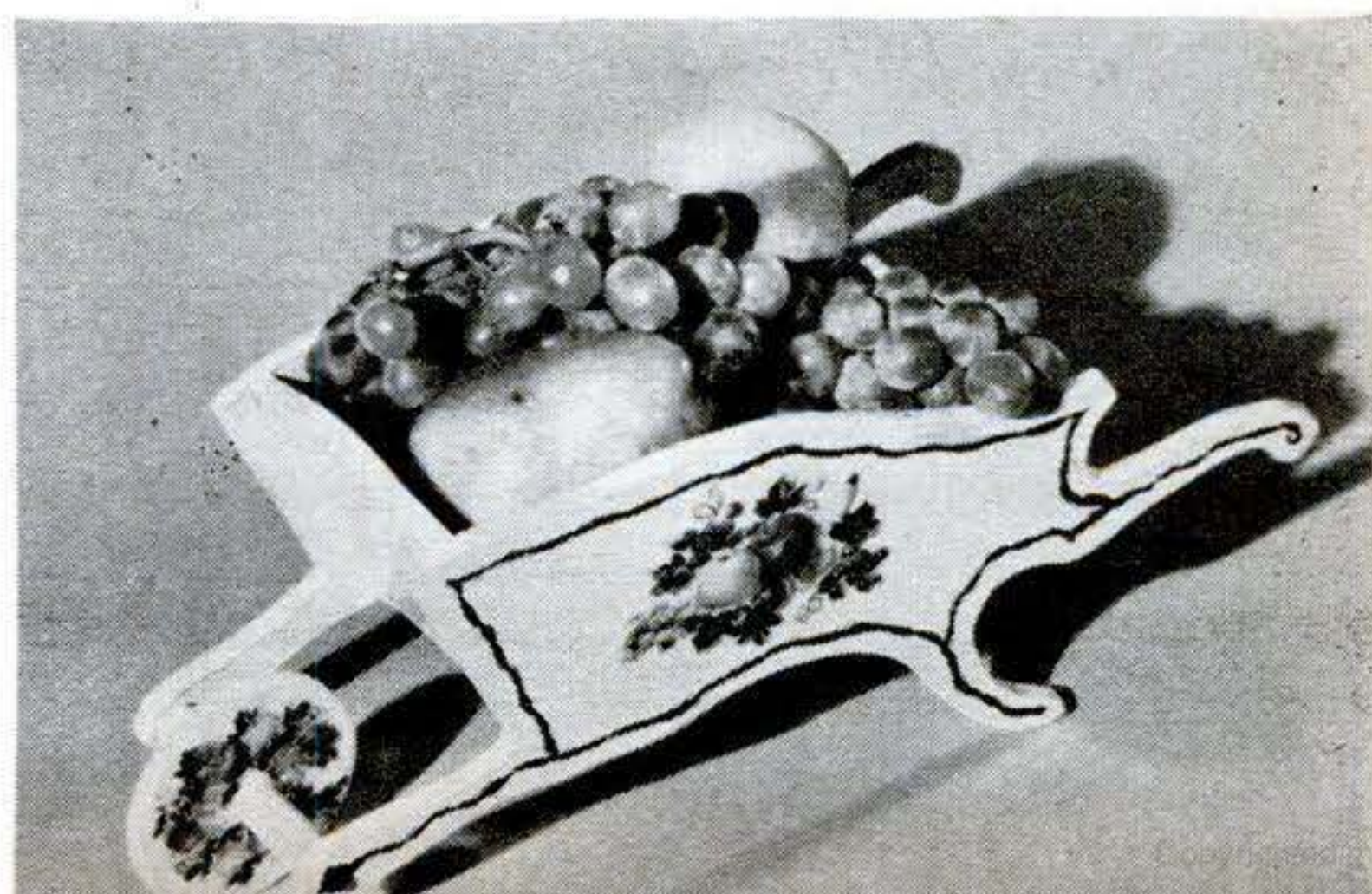
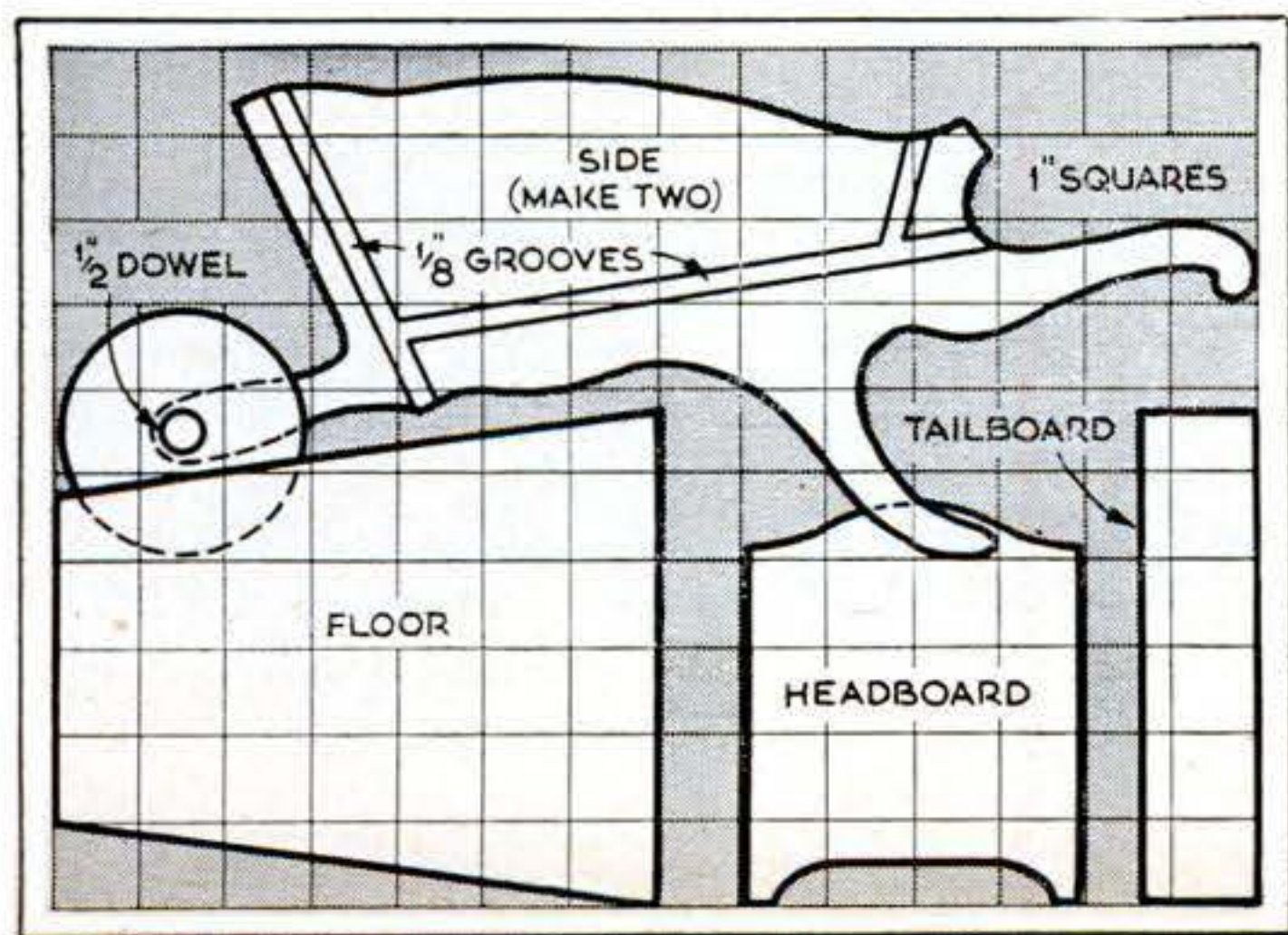


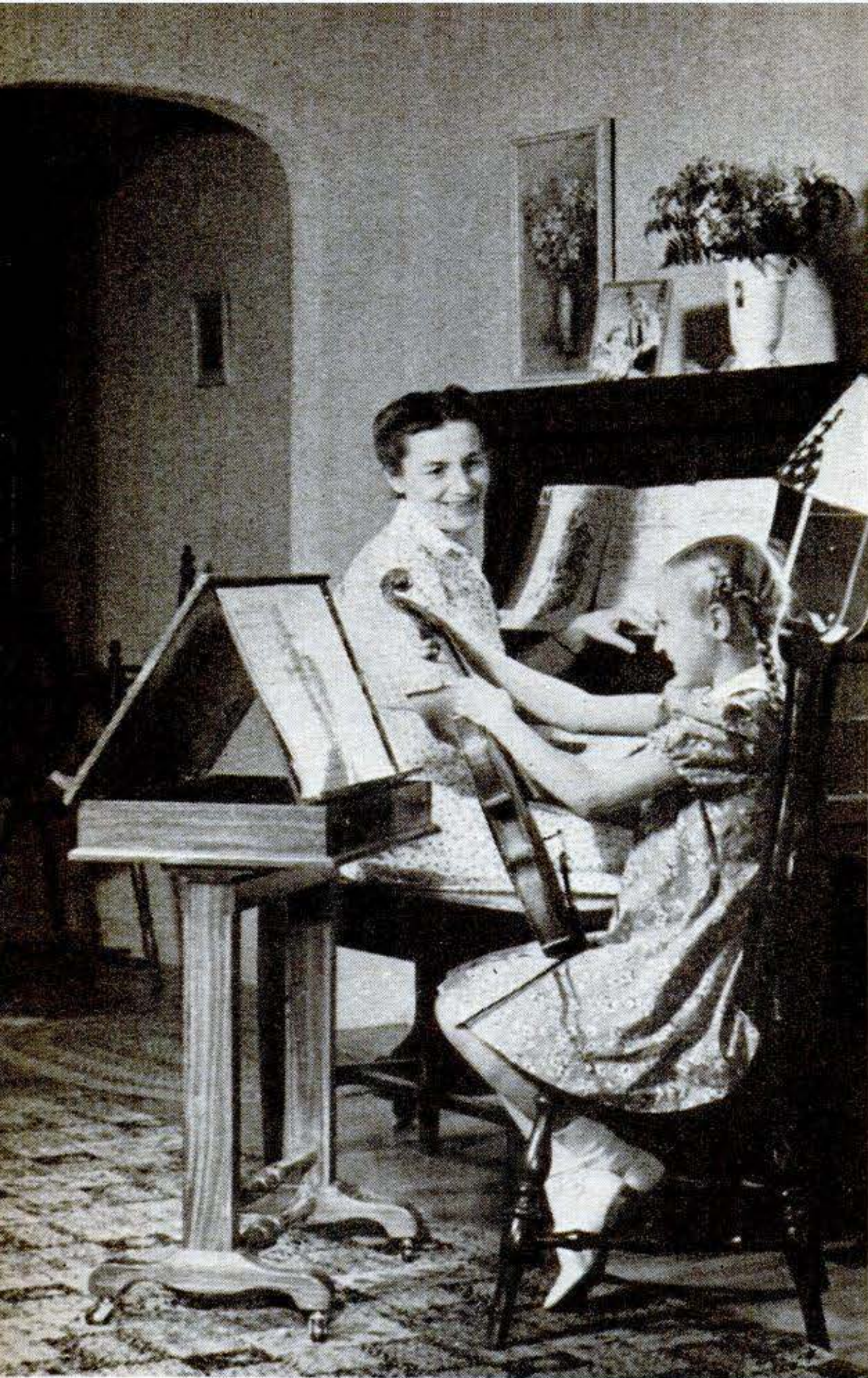
Wheelbarrow with Brilliant Finish Is Attractive Table Piece

THIS glossy white wheelbarrow is handsome enough to serve as the centerpiece of a formal table setting. Three-ply basswood will take an excellent finish, but any soft wood will do if sanded carefully. In dadoing the sides to receive the floor, note that the grooves are halted at the headboard.

Glue the parts together, sand to a satin

smoothness, and apply two coats of flat white paint, followed by a coat of white enamel. Allow 24 hours between each coat and sand with 0000 sandpaper before applying the next. Intertwining red and green lines hand painted around the edges will produce a rope effect. The other designs are put on with decals.—WILLIAM FREEMAN.





Dual-purpose.

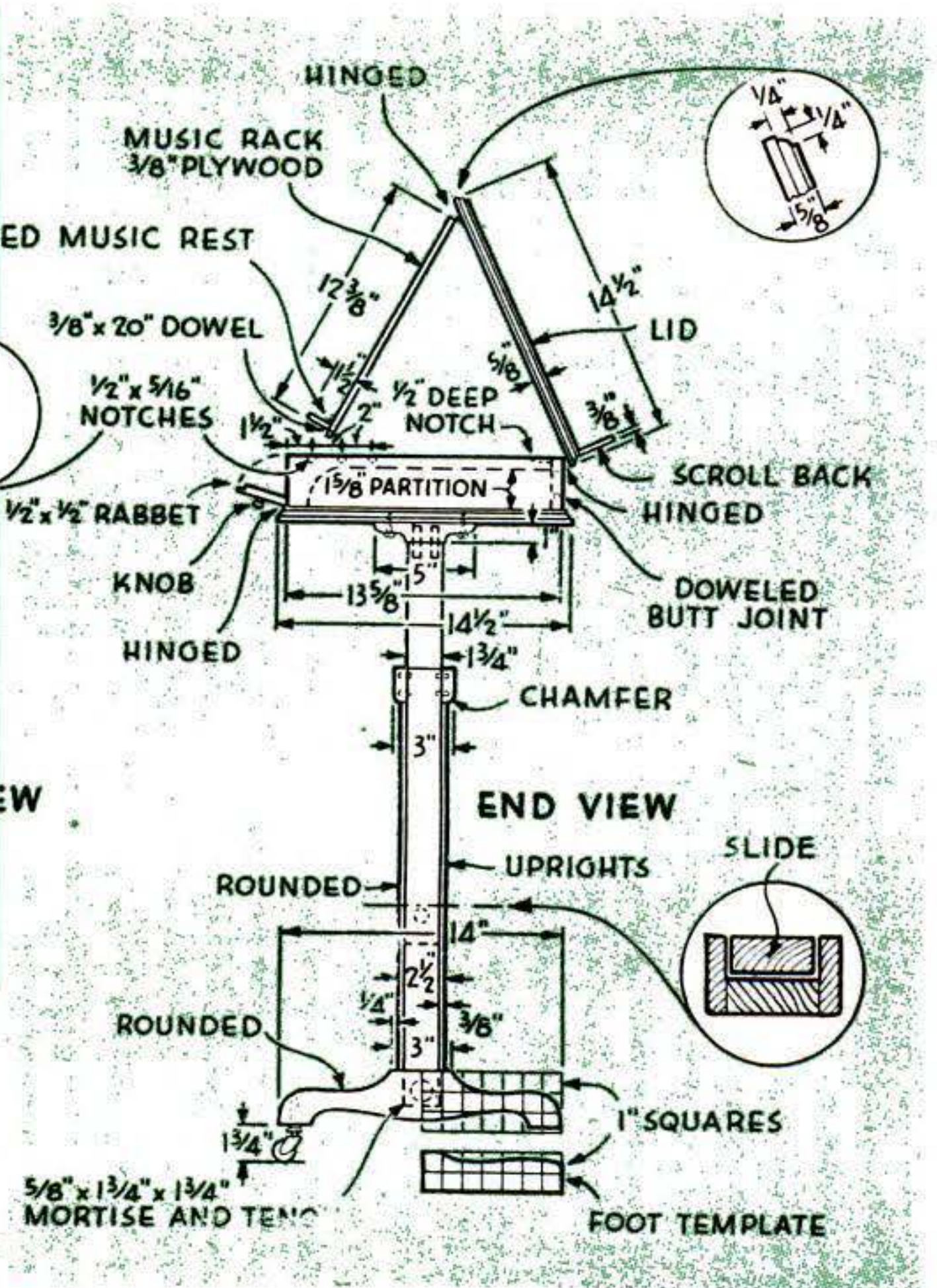
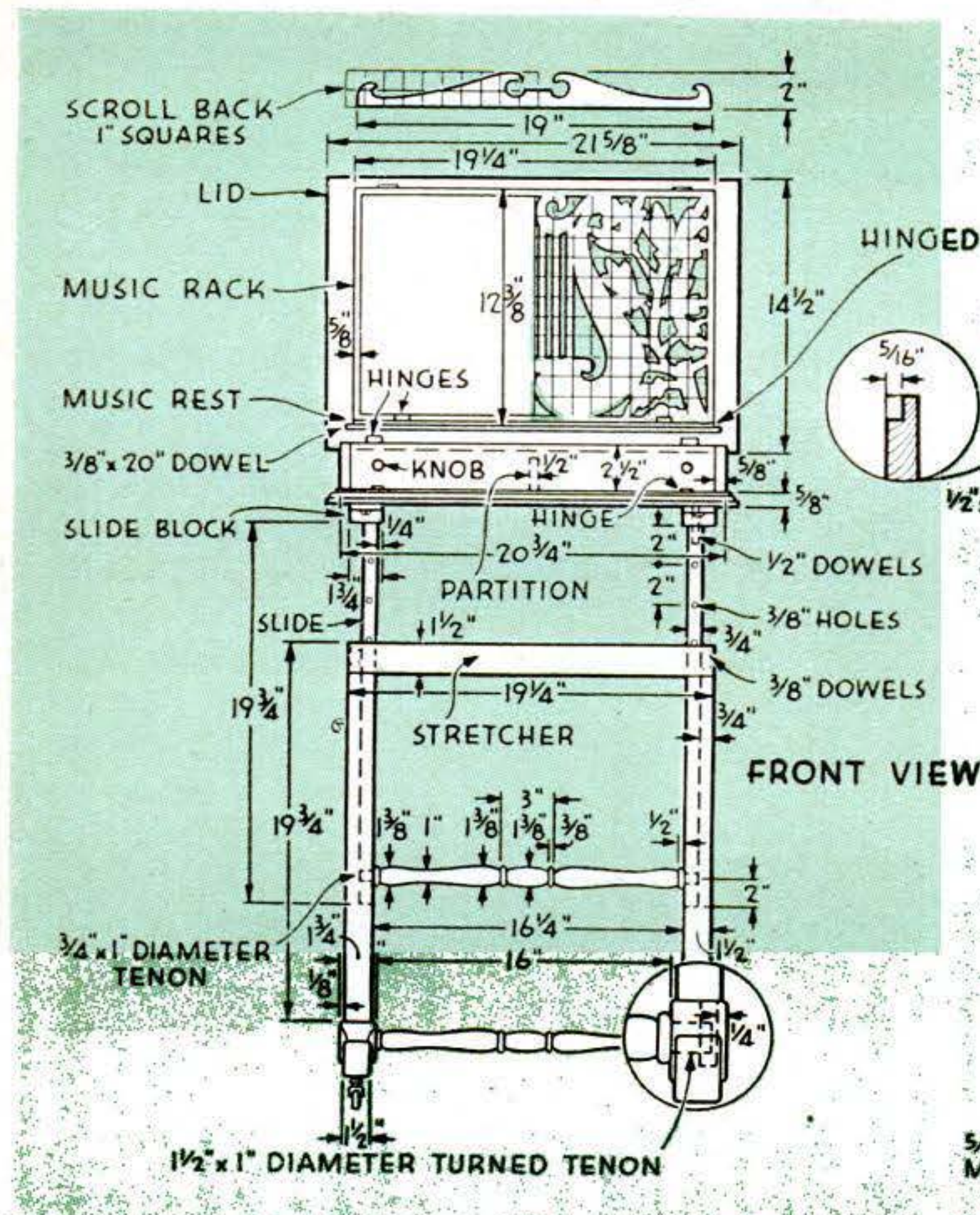
By FRANK HEGEMEYER

OF INTEREST to craftsmen and musicians alike, this period music stand fills a need for a rack that is readily adjustable in height and at the same time provides storage space for sheet music. When not used for music, the stand becomes an attractive side table. The design was adapted from a stand made in 1835.

Space is provided in the generous-size music compartment for some 200 copies of standard 9" by 12" sheet music. A hinged false drawer front makes the music easily accessible. A music rack, which has a scrolled lyre-and-leaf design or may be of plain plywood, is hinged to the lid and folds inside the music compartment when the lid is closed.

The rack can be raised to three different angles by the use of a dowel secured with brads to the bottom of the rack. This dowel rests in notches along the sides of the compartment. The lid, with its broken-pediment back rail, provides an additional rack to hold music so that two persons, one on each side of the stand, can use it simultaneously.

Adjustment of the height of the rack is accomplished by the use of two 3" pins cut



Music Stand

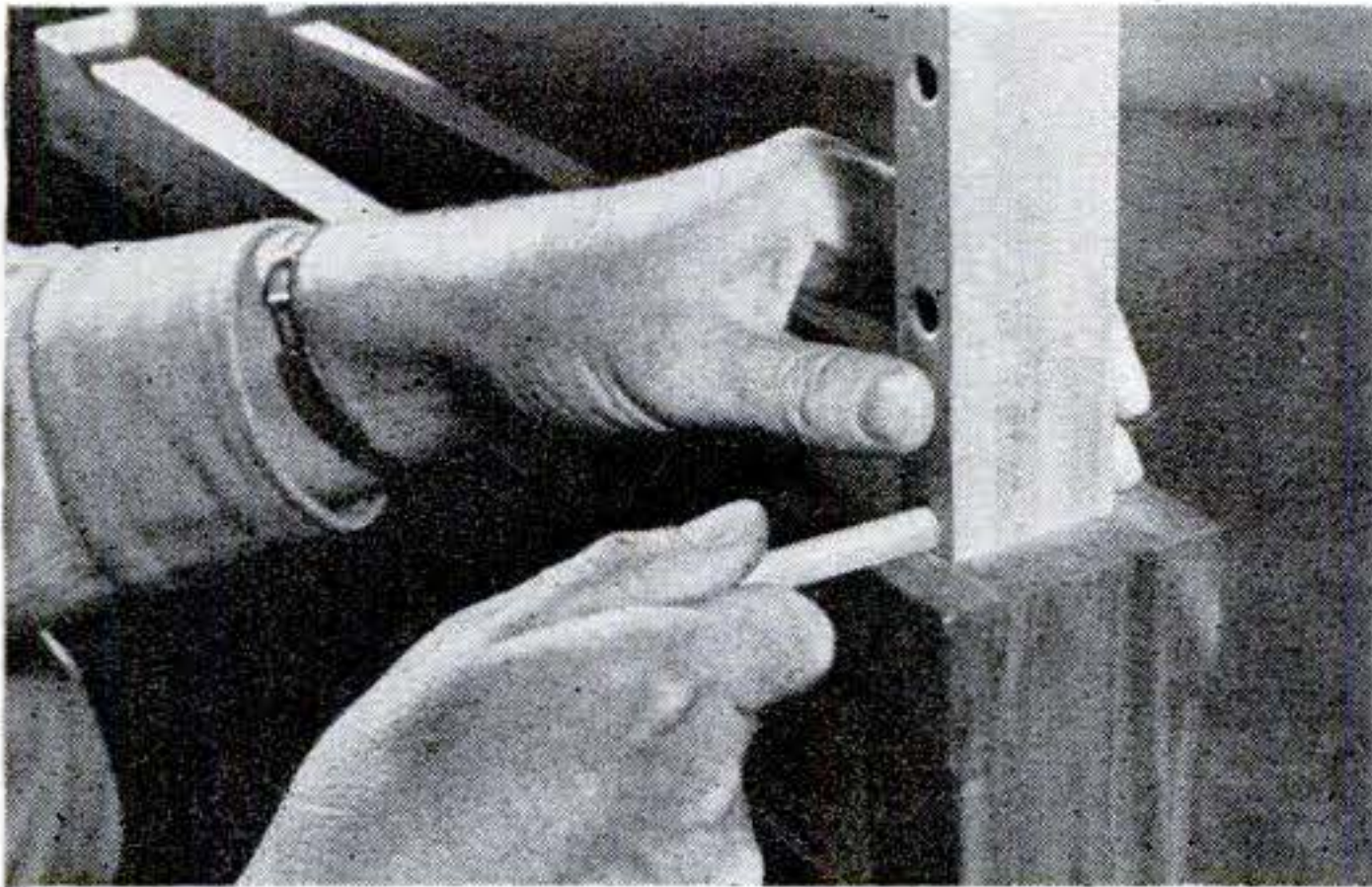
SERVES AS
OCCASIONAL TABLE
WHEN CLOSED

from a dowel. These are inserted in the holes bored in the slides and they rest on the two upper stretchers of the base. A series of eight holes is bored in each slide permitting a height adjustment of the rack from 34" to 50".

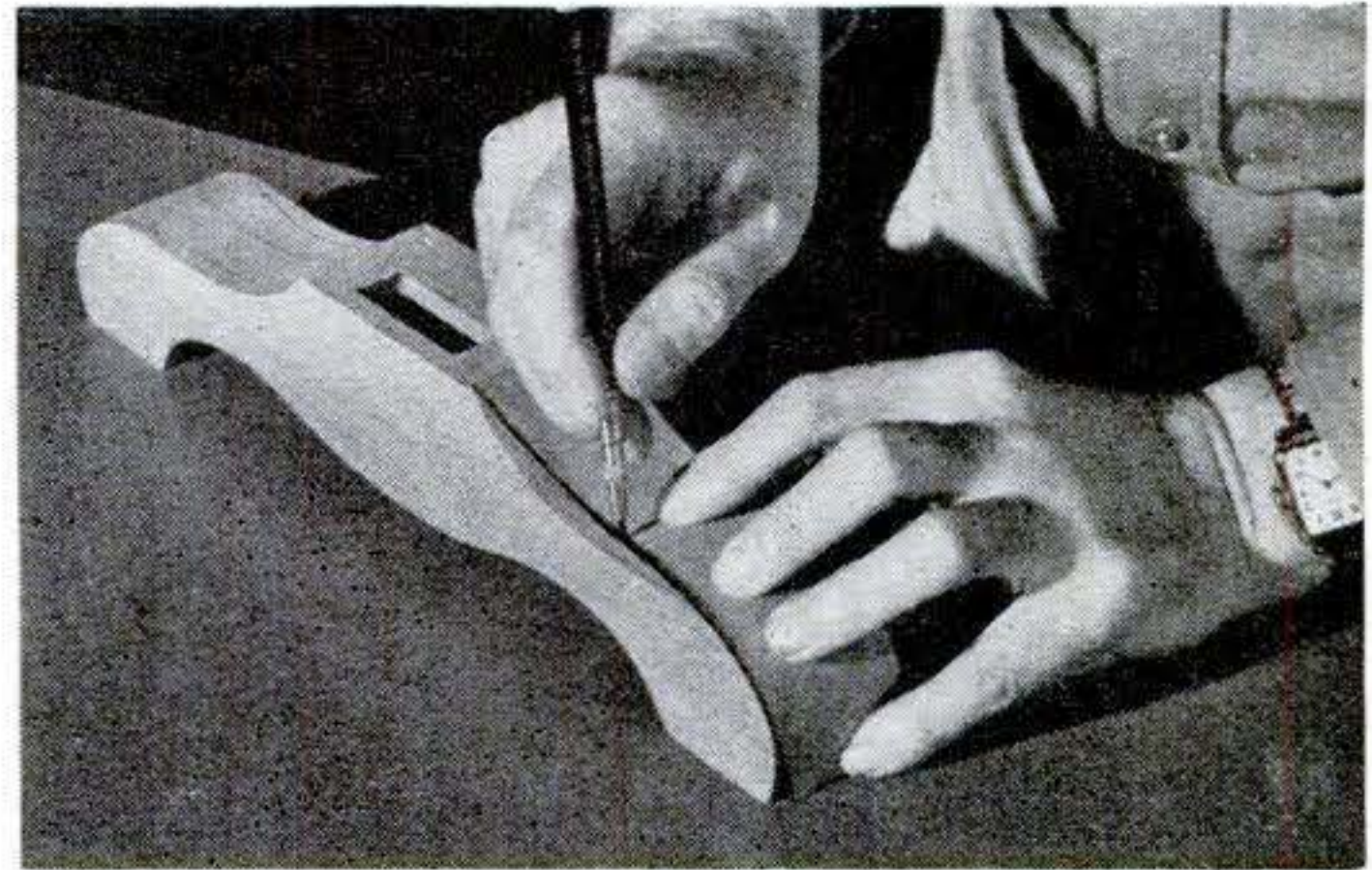
Wood that will take a finish that harmonizes with your piano is suitable for the stand. It is advisable to sand the various parts of the piece as each is made, because they will be hard to get at after assembling.

Blocks for the feet are glued up of three layers of 1" stock. Cut the mortise in the feet for the upright tenon $\frac{1}{4}$ " from the outside edge and bore the holes for the casters. Bandsaw the arch and instep. A cardboard template, cut as shown in the drawing, is then used in scribing the lines for the side cuts, with the smaller end of the template set at the end of a foot.

Channels are formed on the uprights for the slides by gluing strips to the uprights. Cut $\frac{1}{8}$ " away from the outside edge of the lower ends of the uprights to leave a tenon $\frac{5}{8}$ " thick. Round the edges of the uprights and feet before assembling. Bore the holes in the feet for the turned stretcher tenons. Note that the tenons of the uprights are



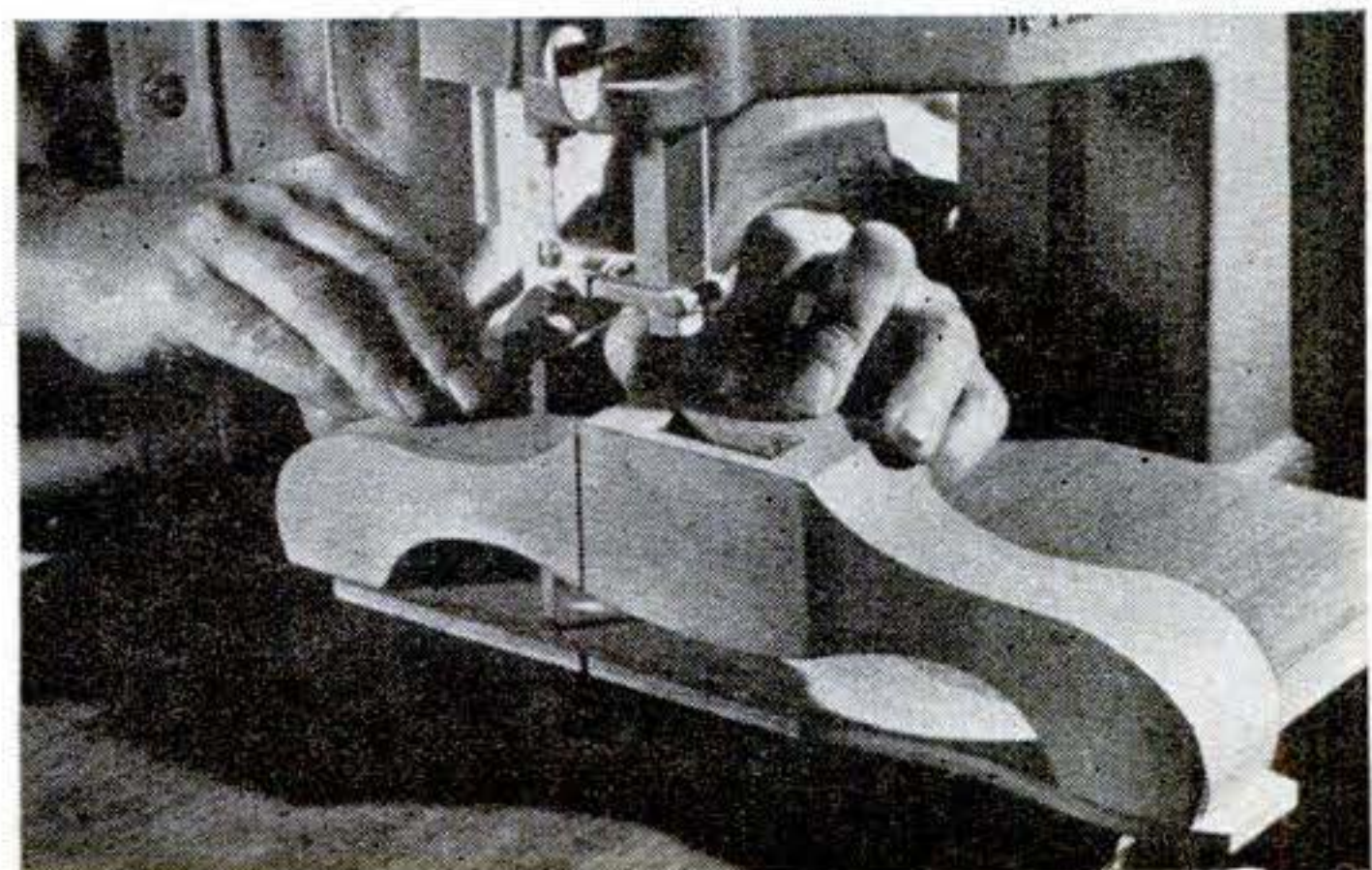
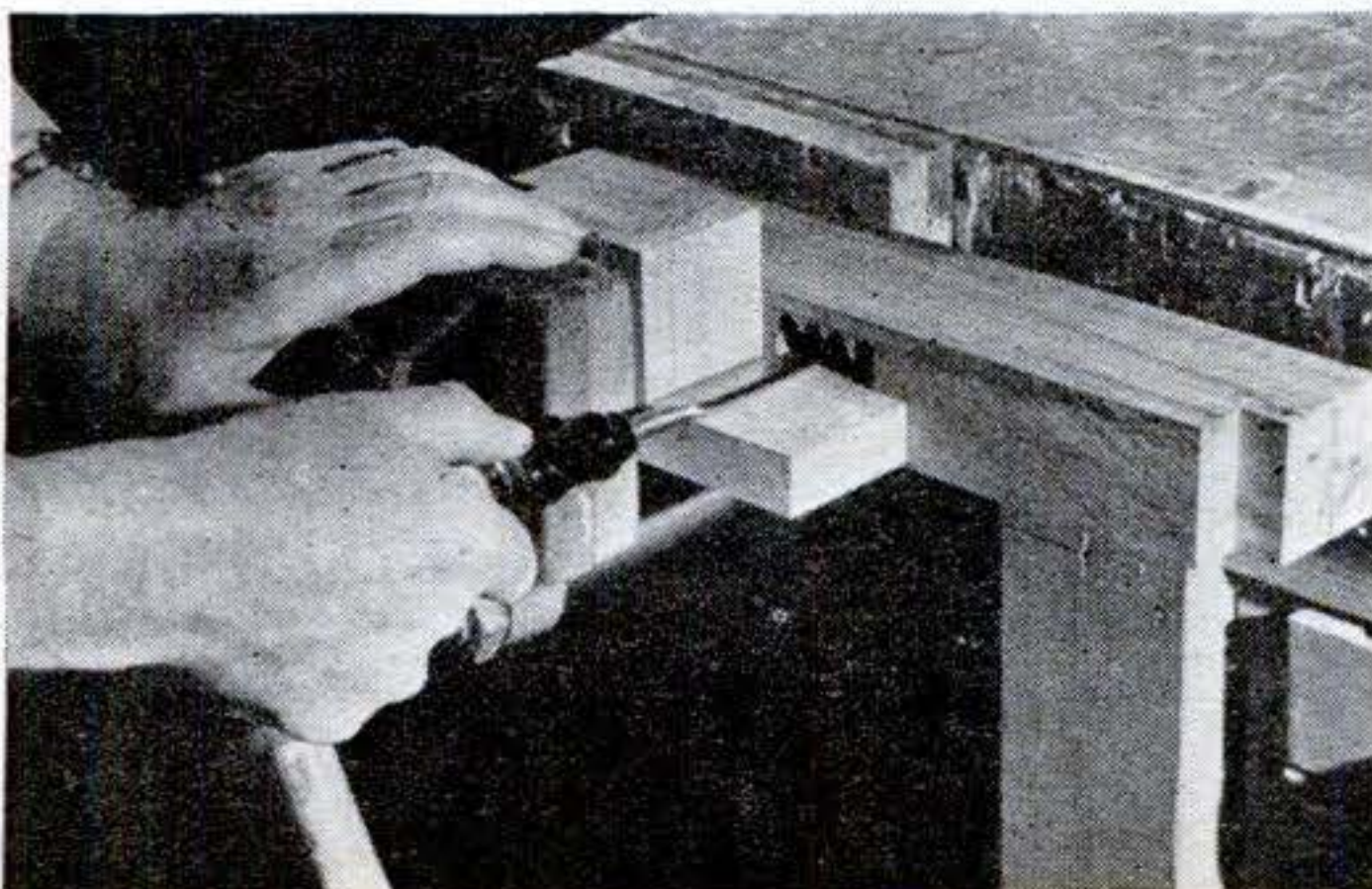
Holes for dowels in the sliding uprights permit eight 2" adjustments in the height of the rack

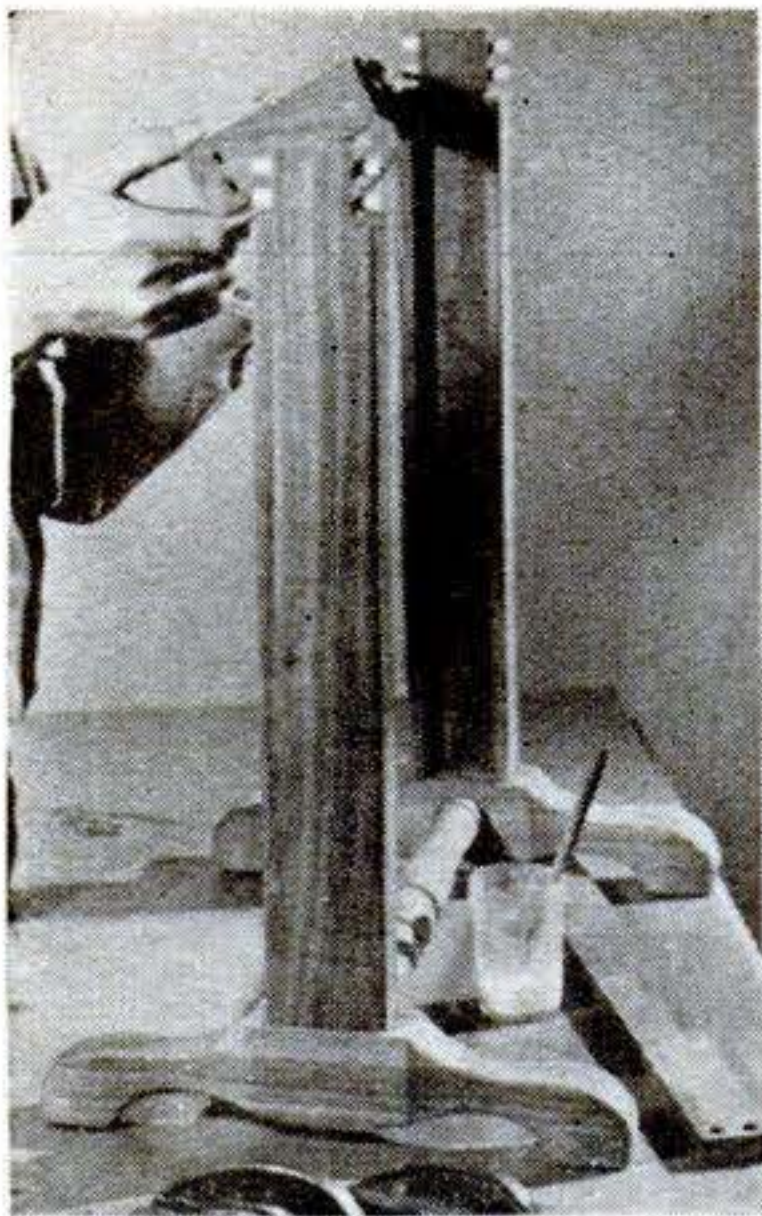


A cardboard template is aligned with one side of the foot when lines on the other side are scribed

Small blocks nailed together form an L to guide the chisel when the mortises are cut in the feet

It is essential to nail a brace across the arch of a foot when sawing the contour of the sides





Glue in the lower stretcher before fitting the legs to the two stretchers at the top



Clamp the sides together and bore $\frac{5}{8}$ " holes $\frac{1}{2}$ " deep at the joint for aligned rack stops

anchored in the feet by these turned tenons. Fit the slide assembly to slip freely in the channels before connecting it to the bottom of the music compartment. The two turned stretchers are identical in shape except for their lengths which vary $1\frac{1}{4}$ ".

Shape the edges of the lid and bottom of the music compartment as shown in the drawing. It is advisable to glue up the stock for the lid of $\frac{3}{4}$ " lumber with the heart and sap sides alternating to minimize warping, then dress it down to $\frac{5}{8}$ ". Notches for adjusting the angle of the rack are made by clamping the sidepieces face to face and boring $\frac{5}{8}$ " vertical holes $\frac{1}{2}$ " deep in the joint between them. The notches thus formed are correctly aligned for receiving the propped-up rack. The ends of the music compartment are jointed to the back with doweled butt joints, and the back rail is doweled to the lid.

Make a cardboard cutout design of the music rack and mark the pattern on plywood. Flatten on one side a dowel long enough to reach between the notched sides of the music compartment, and brad it to the bottom of the rack.

After a trial fit, assemble the stand with a good grade of glue. Apply a filler to open-grained wood, wiping it off across the grain. Sand lightly and then finish the stand with varnish or lacquer.

LIST OF MATERIALS

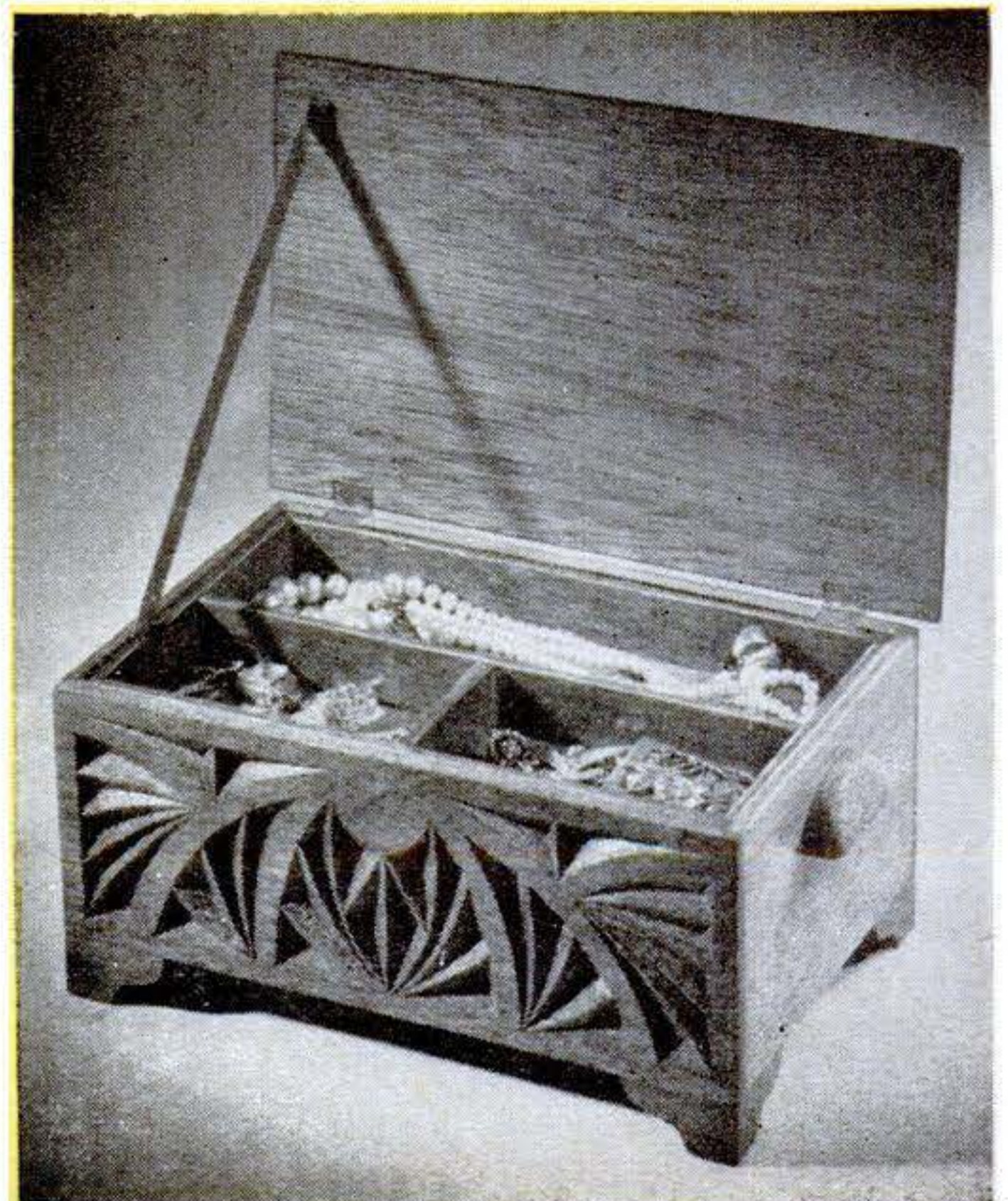
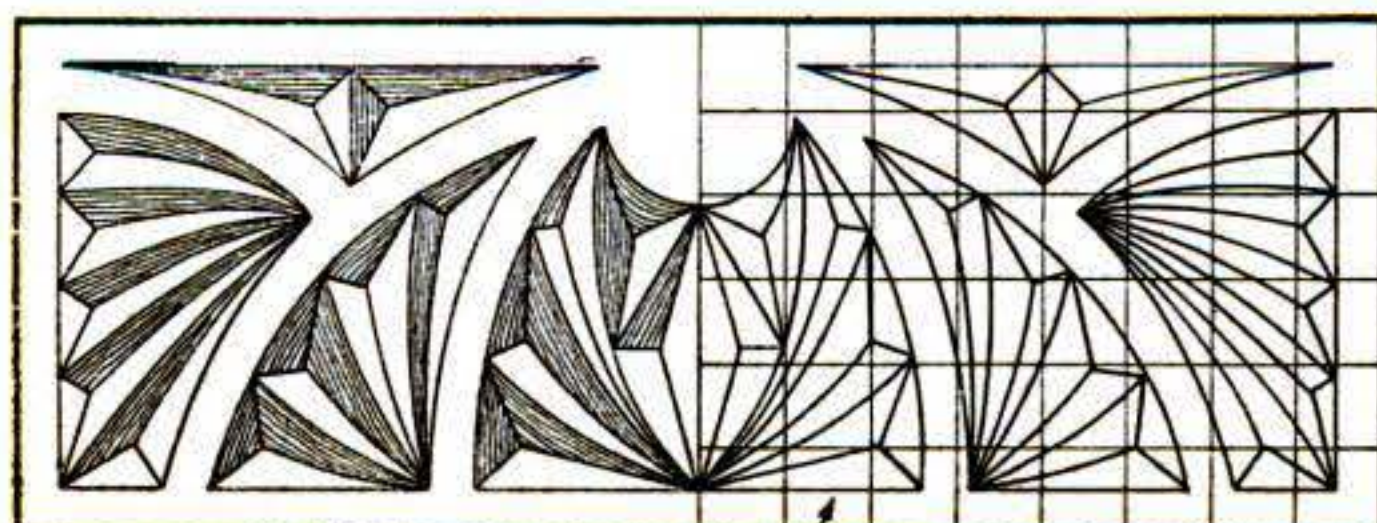
No. Pc.	Description	T.	W.	L.
2	Foot blocks	$13\frac{3}{4}$	$23\frac{3}{4}$	14
2	Upright center pieces	$3\frac{3}{4}$	$13\frac{3}{4}$	$19\frac{3}{4}$
4	" strips	$3\frac{3}{8}$	$11\frac{1}{2}$	$18\frac{1}{4}$
2	Top stretchers	$5\frac{5}{8}$	$11\frac{1}{2}$	$19\frac{1}{4}$
1	Feet stretcher	$13\frac{3}{8}$ dia.		19
1	Slide "	$13\frac{3}{8}$ "		$17\frac{3}{4}$
2	Slides	$3\frac{3}{4}$ "	$13\frac{3}{4}$	$19\frac{3}{4}$
2	Slide blocks	1	$13\frac{3}{4}$	5
1	Compartment bottom	$5\frac{5}{8}$	$14\frac{1}{2}$	$21\frac{5}{8}$
2	" sides	$5\frac{5}{8}$	$21\frac{1}{2}$	$13\frac{5}{8}$
1	" back	$5\frac{5}{8}$	$21\frac{1}{2}$	$19\frac{1}{2}$
1	False drawer front	$5\frac{5}{8}$	$21\frac{1}{2}$	$19\frac{7}{16}$
1	Partition	$1\frac{1}{2}$	$15\frac{5}{8}$	12
1	Lid	$5\frac{5}{8}$	$14\frac{1}{2}$	$21\frac{5}{8}$
1	Back rail	$3\frac{3}{8}$	2	19
1	Music rack (plywood)	$3\frac{3}{8}$	$12\frac{3}{8}$	$19\frac{1}{4}$
1	" rest "	$3\frac{3}{8}$	$11\frac{1}{2}$	$19\frac{1}{4}$
1	Dowel	$3\frac{3}{8}$ dia.		20

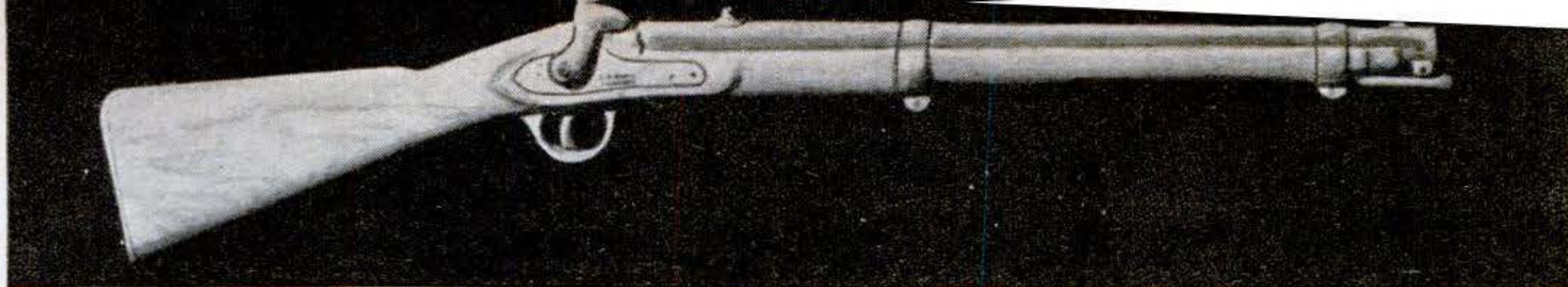
2 drawer knobs; 4 1" hinges (for lid and drawer front); 4 $\frac{3}{4}$ " hinges (for rest and rack); 4 casters.

Note: All dimensions are given in inches.

Design in Gothic Manner Adorns This Chip-Carved Jewel Box

Curved geometrical motifs on the front panel of this jewel box represent one of the most effective techniques of the chip carver. Strongly Gothic in feeling, this particular design employs a modified form of the triangular patterns usually followed in such carving. As with pyramids, the curving units of this design are formed by vertical cuts made first on three inner lines, then followed by sloping cuts carried from the outer limits until they meet the vertical incisions, thus freeing the chip. Use a chip-carving knife or a skew chisel. The box is 3" by 5" by 8"; the stock is $\frac{1}{4}$ " except for the front, which is $\frac{3}{8}$ " thick to allow carving $\frac{1}{4}$ " deep.—ARNOLD C. WATSON.





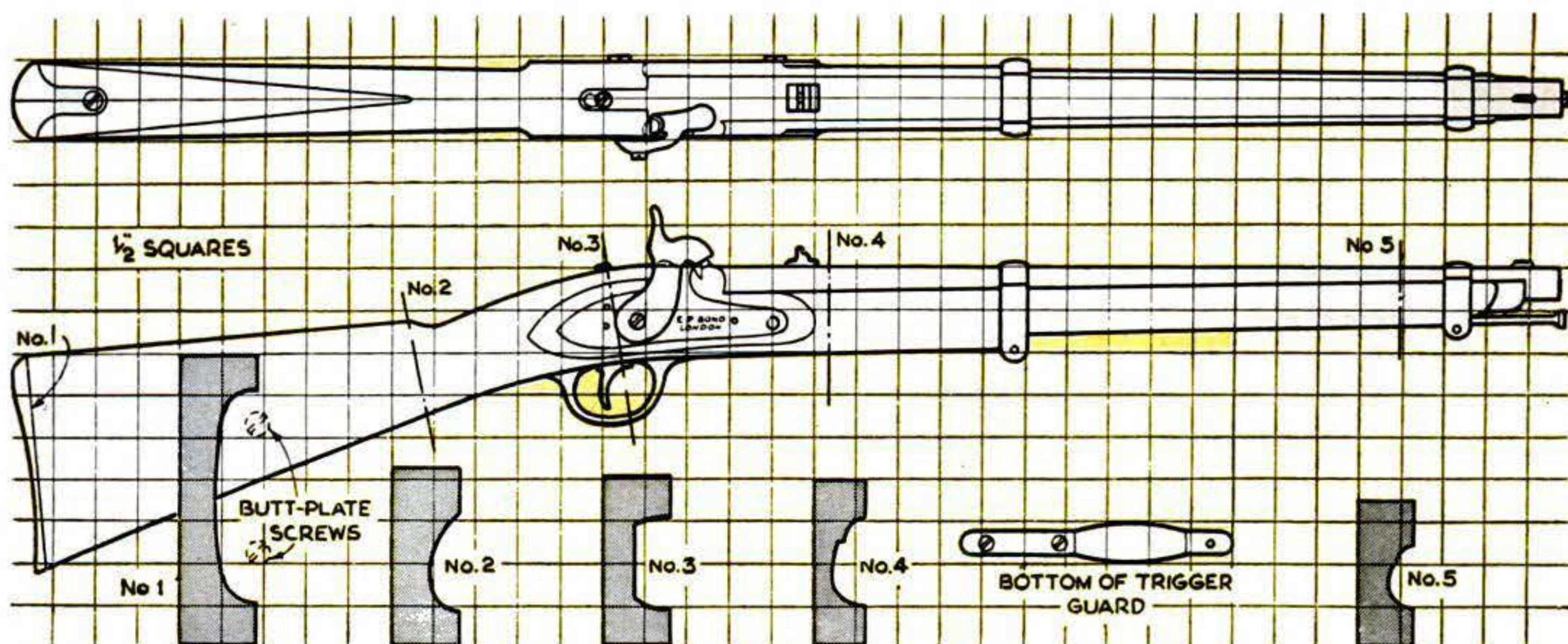
Ball-and-Cap Gun

MODEL OF CIVIL WAR WEAPON IS WHITTLED IN WHITE PINE

PROBABLY used during the War Between the States, the prototype of this ball-and-cap gun was made in England and is a fine-looking specimen. For a half-size model of white pine, which is easy to work, the over-all measurements should be 18 13/32" long and 7/8" thick, not including the hammer, which is made last and doweled and

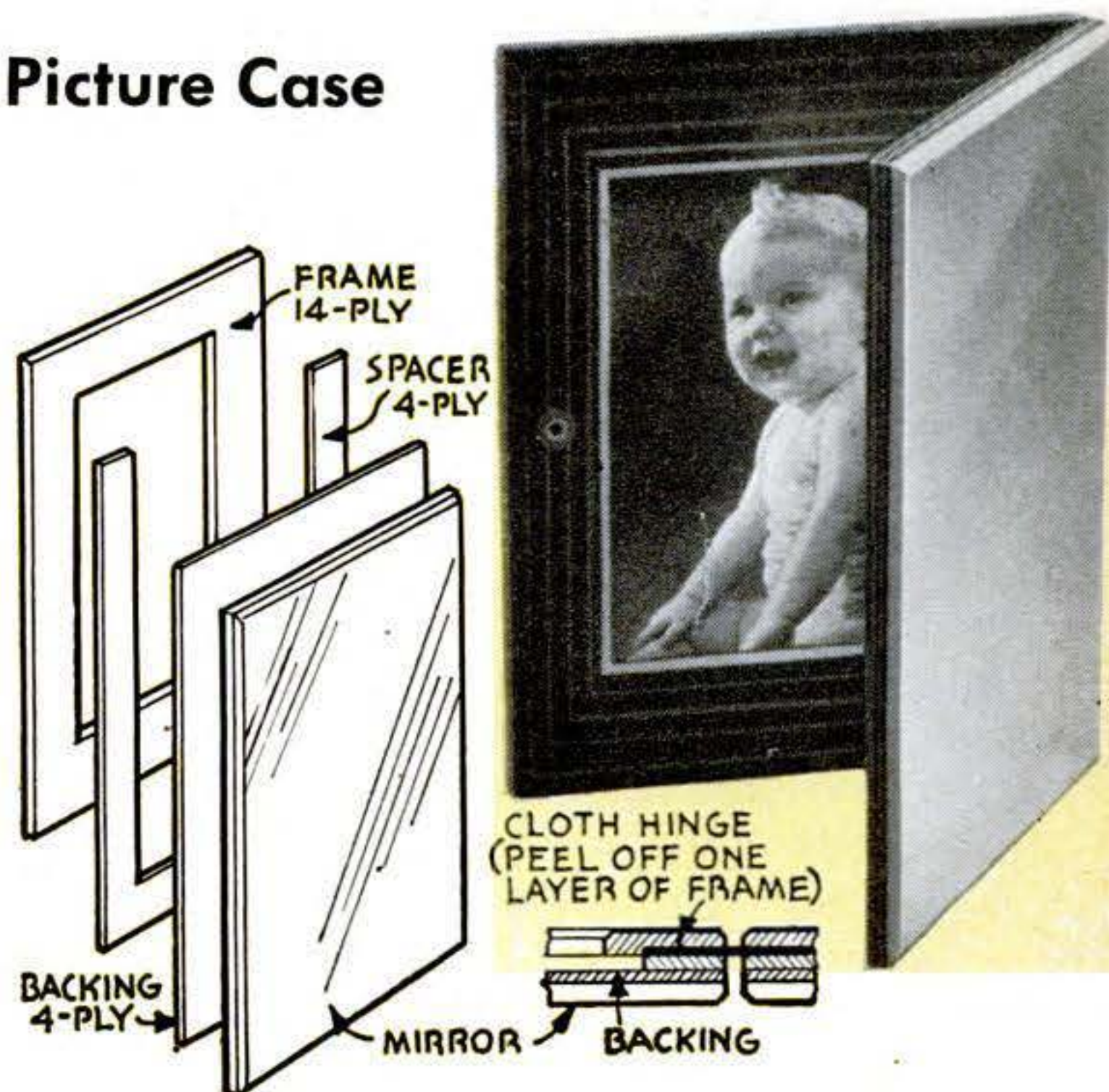
glued in place. Cut the blank on the scroll saw, cutting on the outside of the line, and sawing the trigger and inside of the trigger guard first. Draw a center line all the way around the edge of the blank to balance the whittling, and work from the center line on both sides. Shape the trigger and guard last to avoid breakage, working against the grain.

Add the ramrod and make small V-cuts at the butt, the side plate, and the trigger-guard plate; then carefully sand the entire model smooth. The inscription of the manufacturer may be put on the right side-plate with a sharp pencil.—CARL R. ERICH.



Mirrors Form Covers of Pocket Picture Case

DOUBLE-FACE pocket mirrors will be found suitable for making the covers of this pocket picture case. Pry the two faces of a mirror apart with a razor blade, first softening the shellac with a few drops of alcohol. Cut to size and shellac two pieces of four-ply showcard board to the backs of the mirrors. Use the same cardboard for the 1/4" marginal strips, and affix them with glue. The picture frames are made of 14-ply board. Before being cut, the cardboard is given two coats of varnish and a coat of floor wax. A decorative design can be tooled on the cardboard frame, while the two halves of a snap fastener are cemented in recesses cut in each frame.—F. S.



SPECIAL JOINTS YOU CAN MAKE *with* HAND TOOLS

By Edwin M. Love

WOODWORKING joints based on the tenon and on the half lap have been devised in a variety of modifications. In general, the simpler you can make these forms, the better they will be, not only because they can be made more quickly, but also because the difficult fitting together of a number of pieces tends to weaken a joint, defeating one of the principal purposes of good design.

Why is the double mortise and tenon widely used?

Among the simpler joints, the double mortise and tenon is the best for many purposes, for it holds a natural advantage over the joint made with a single tenon. It replaces a very wide tenon with two narrow ones, thus permitting two mortises with stiff sides rather than one wide mortise with springy sides and also providing considerably more surface for gluing. The following routine is standard practice in the making of such joints for paneled doors.

Square the rail stock first; then lay out the tenon shoulders, squaring around the piece by pressing the stock of the try square against the face side or face edge. Mark the lines with a sharp, hard pencil or a knife. Do not score deeply with a blade because it will crush back the shoulder corners and prevent a perfect fit in the finished joint.

Since the edge of the stile is grooved to receive a panel, draw a second line to guide in cutting a tenon haunch, to close the end of this groove, as shown in one of the drawings on page 154. Gauge the thickness of the tenons on the edges and ends, working from the face side, and gauge the mortises in the stile with the same setting, assuring

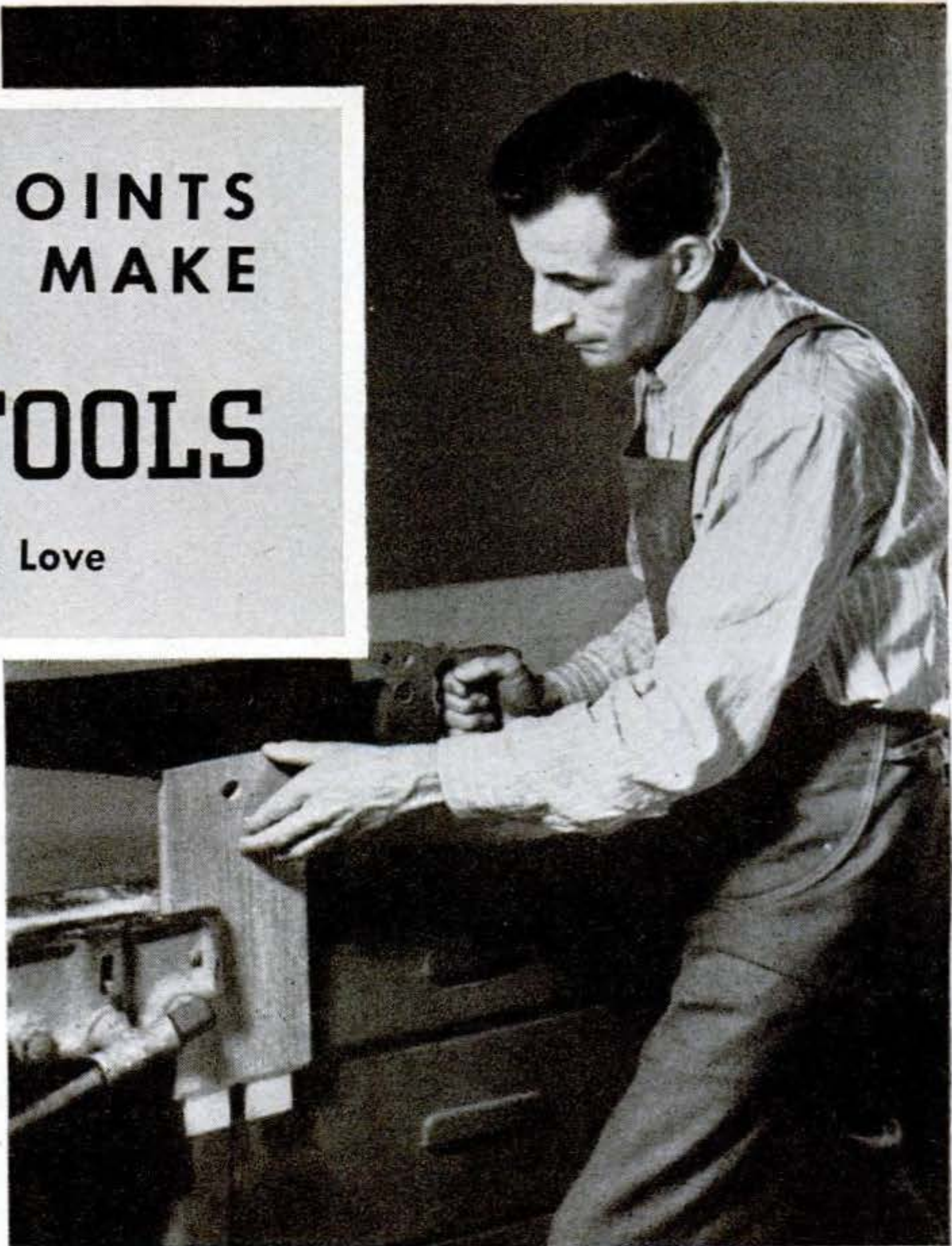
Before ripping the cheek of a double tenon, bore a hole to gauge the base of the center division

flush faces upon assembly. In paneled structures the thickness of a tenon is determined, of course, by the thickness of the panel.

Gauge the tenon widths from the face edge and bore a hole at the base of the center division (at the same depth as the haunch). The bottom of the lower tenon shown is flush with the groove in the rail. Never cut the slot between the tenons back entirely to the shoulder of the rail, since to do so would be to eliminate wood that matches the groove of the stile and obviously adds to the strength of the mortised joint.

In forming the tenons, rip the sides, or cheeks, before cutting the shoulders. This allows the waste to support the saw. There is also less likelihood of cutting into the tenon since the waste falls away as the shoulders are cut.

After boring the mortises, chisel them from both ends, finally trimming the ends to the line. Smoothly cut ends offer considerable bracing support and relieve the glue of much strain. Allow a little clearance



at the bottom of the mortises for surplus glue and imprisoned air. Before assembling, chamfer the tenon ends to prevent marring of the mortise sides.

The tenon should enter snugly but without bulging the mortise. Smooth contact is required for good gluing strength. If the shoulders do not fit snugly, run a backsaw or a dovetail saw into the joint.

What is a bevel-shoulder joint? It is a mortise and tenon in two members meeting at an acute angle. The full thickness of the tenoned piece is notched into the mating piece to one seventh the depth of the latter, as shown in a drawing. This joint is used more in heavy structural framing than in furniture, yet it can be employed to advantage in some home workshop projects.

To lay out the joint, work from the face edges and employ a bevel square for marking the angles. Saw out the notch and then

lay the severed piece upon the member to be tenoned, carefully adjusting the angle before using it as a pattern to mark the tenon shoulder. Square the front of the tenon with the edge of the mortised member, not with the slope of the notch. A well-planned tenon should fit quite snugly into the mortise.

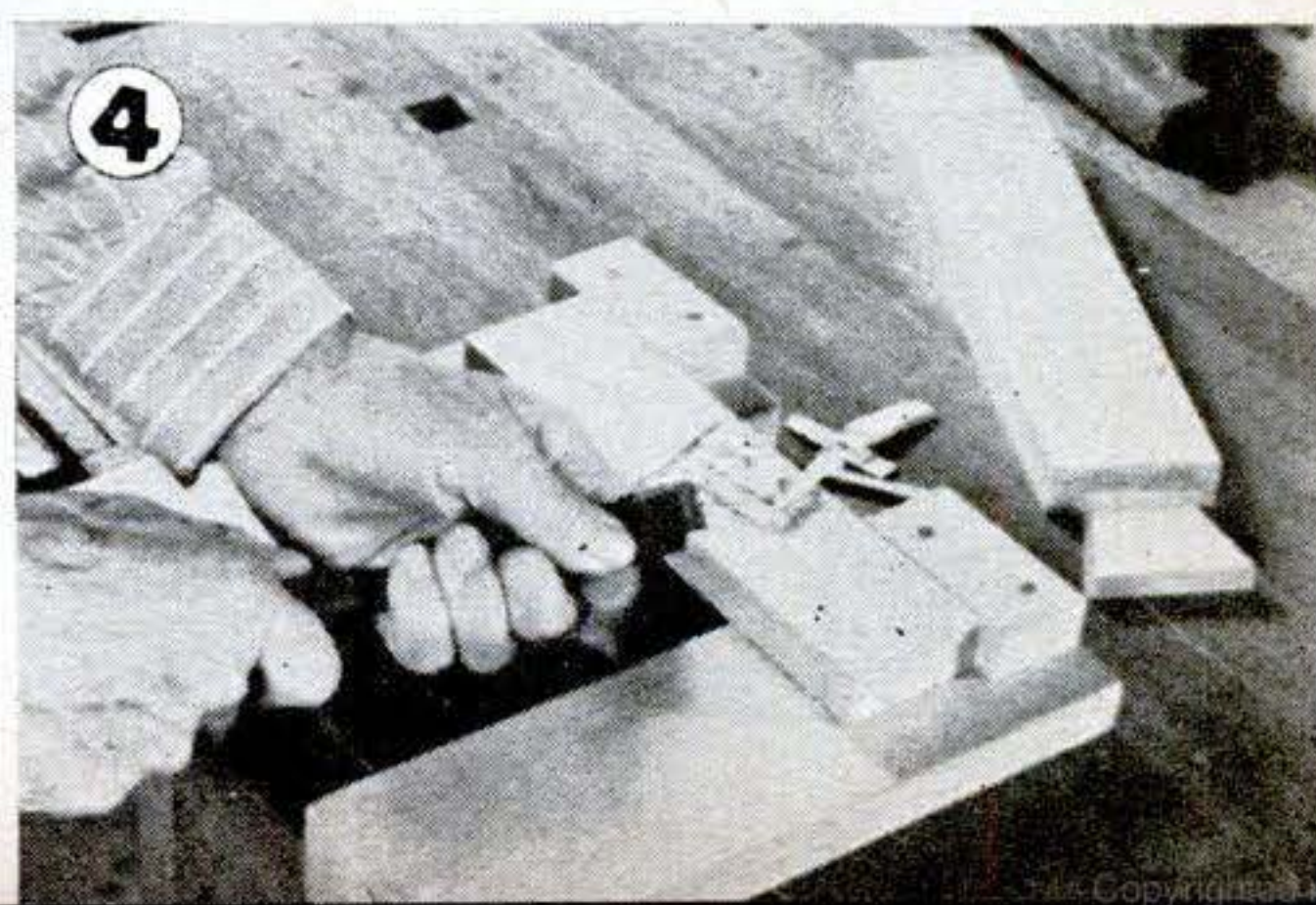
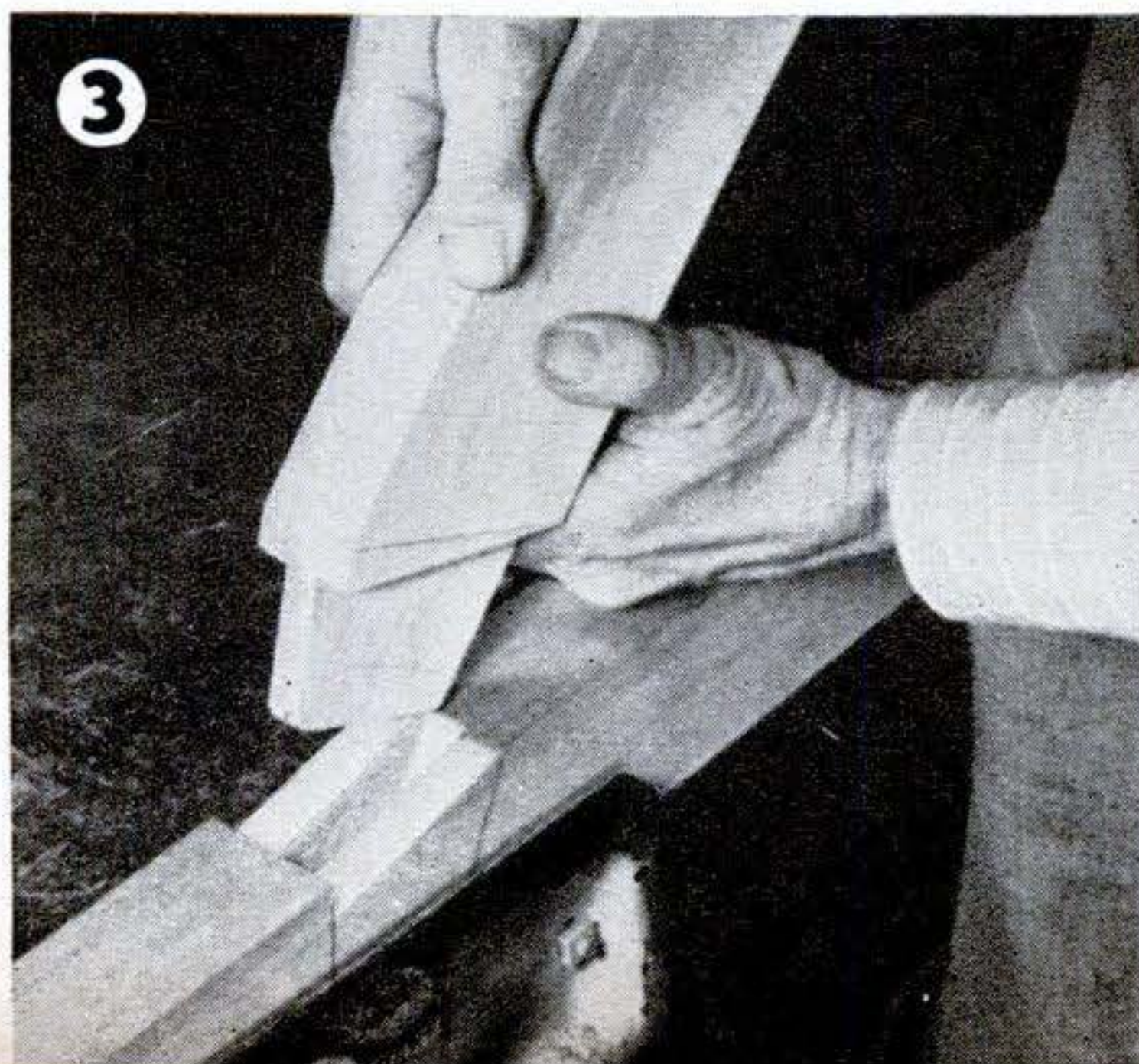
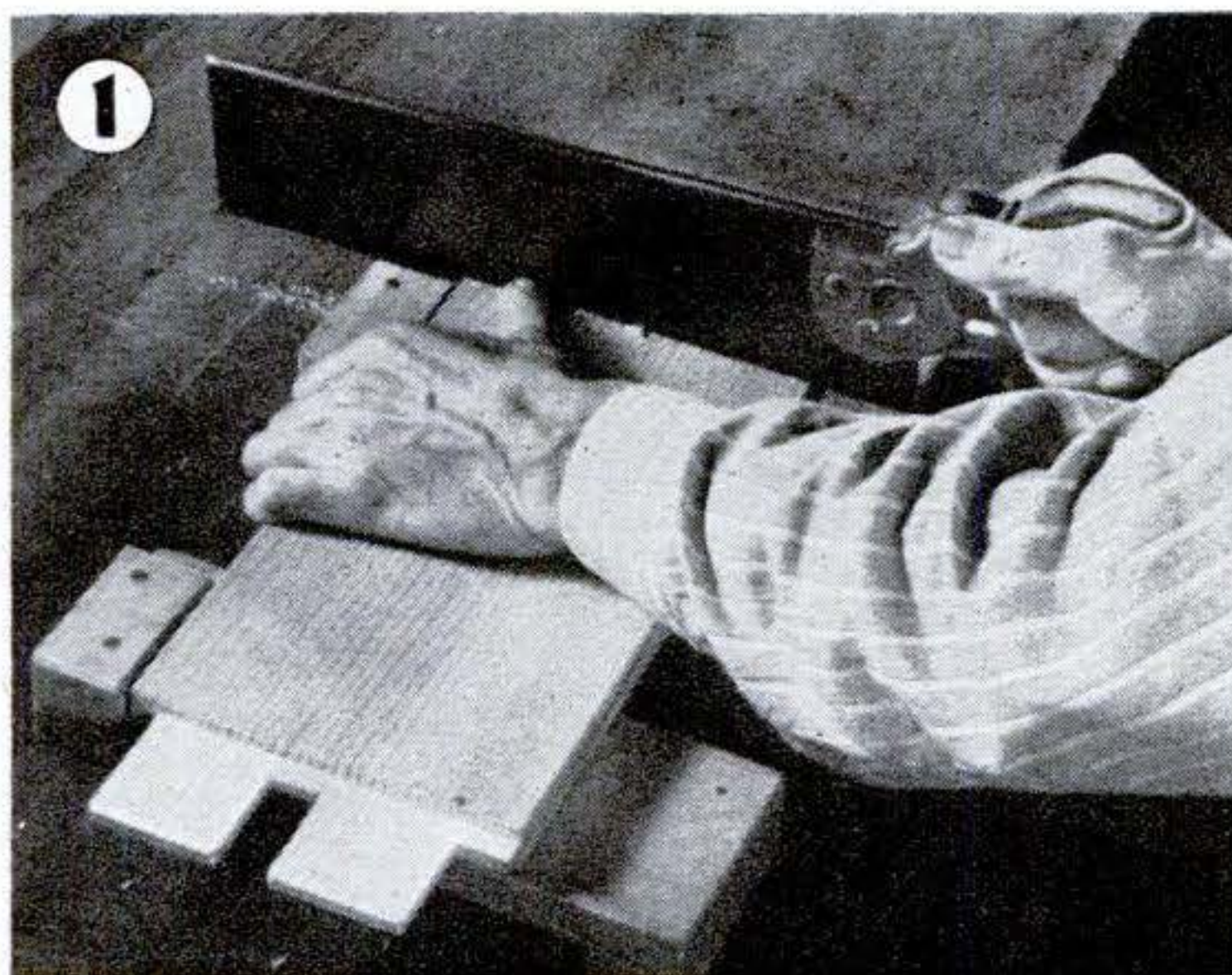
When is a keyed mortise-and-tenon joint useful? This joint involves a through mortise with a tenon having a slot into which a wedge is driven outside the joining member, against which it bears. The joint, though rigid, can easily be taken apart by driving out the wedge. It is useful in any structure that may, upon occasion, be dismantled, such as portable camp furniture or benches. Many variations of the joint are possible. When designing, make sure that the slot in the tenon extends well into the mortise, so the wedge when driven in will bear solidly

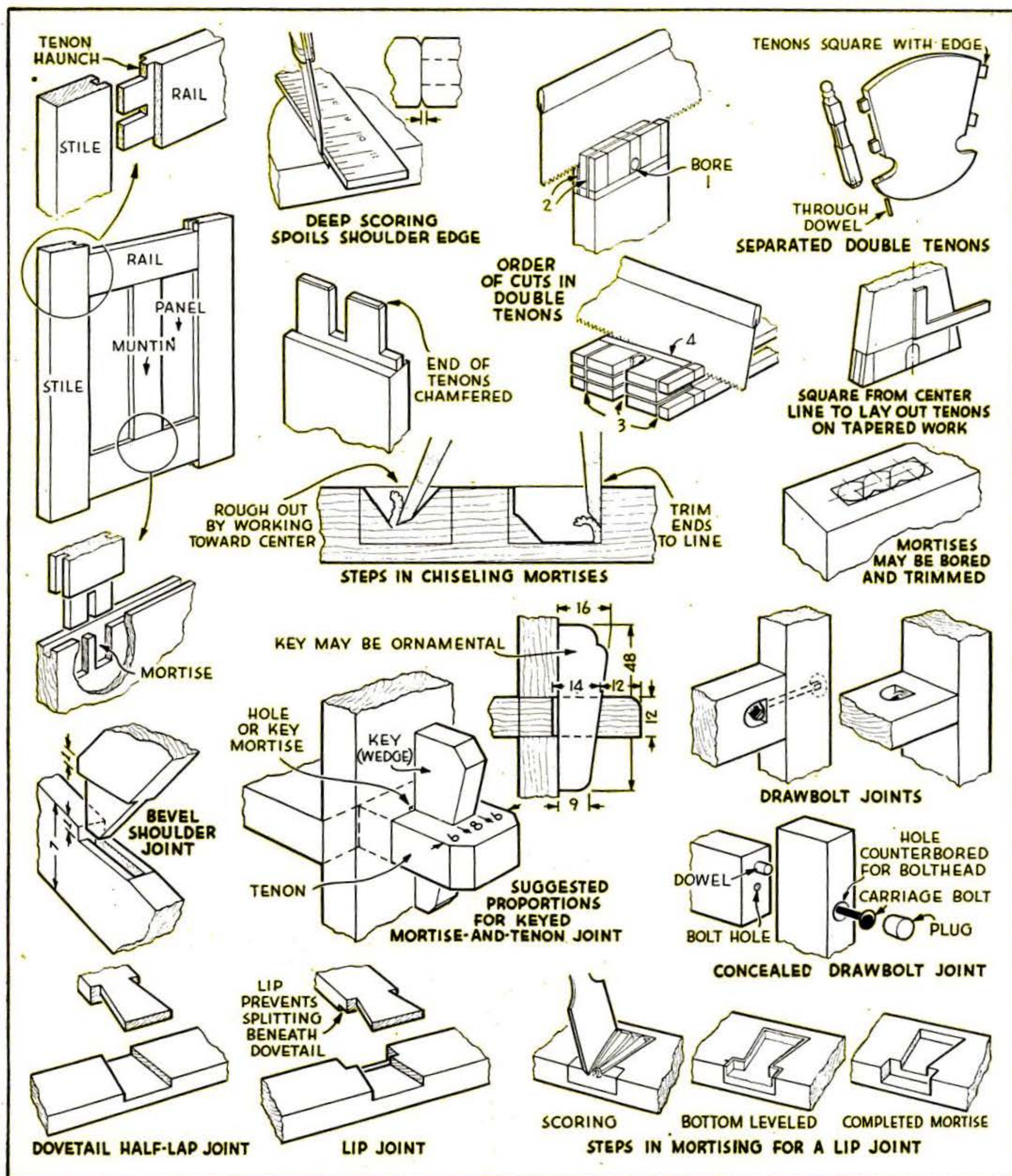
1 No other saw is as good as a backsaw, often called a tenon saw, for cutting shoulders of a double tenon. Guide the saw with a thumb

3 A bevel-shoulder joint, in which the tenoned piece itself is notched into the mating one, gives additional strength to a mortise and tenon in structures that bear great weight

2 Deep mortises are usually bored out before being trimmed, but shallow ones can be cut with a chisel alone. Trim the ends last

4 When chiseling the mortise for a dovetailed half-lap joint, first score across the grain with a wide chisel, then bevel toward both edges, and finish by leveling off the bottom





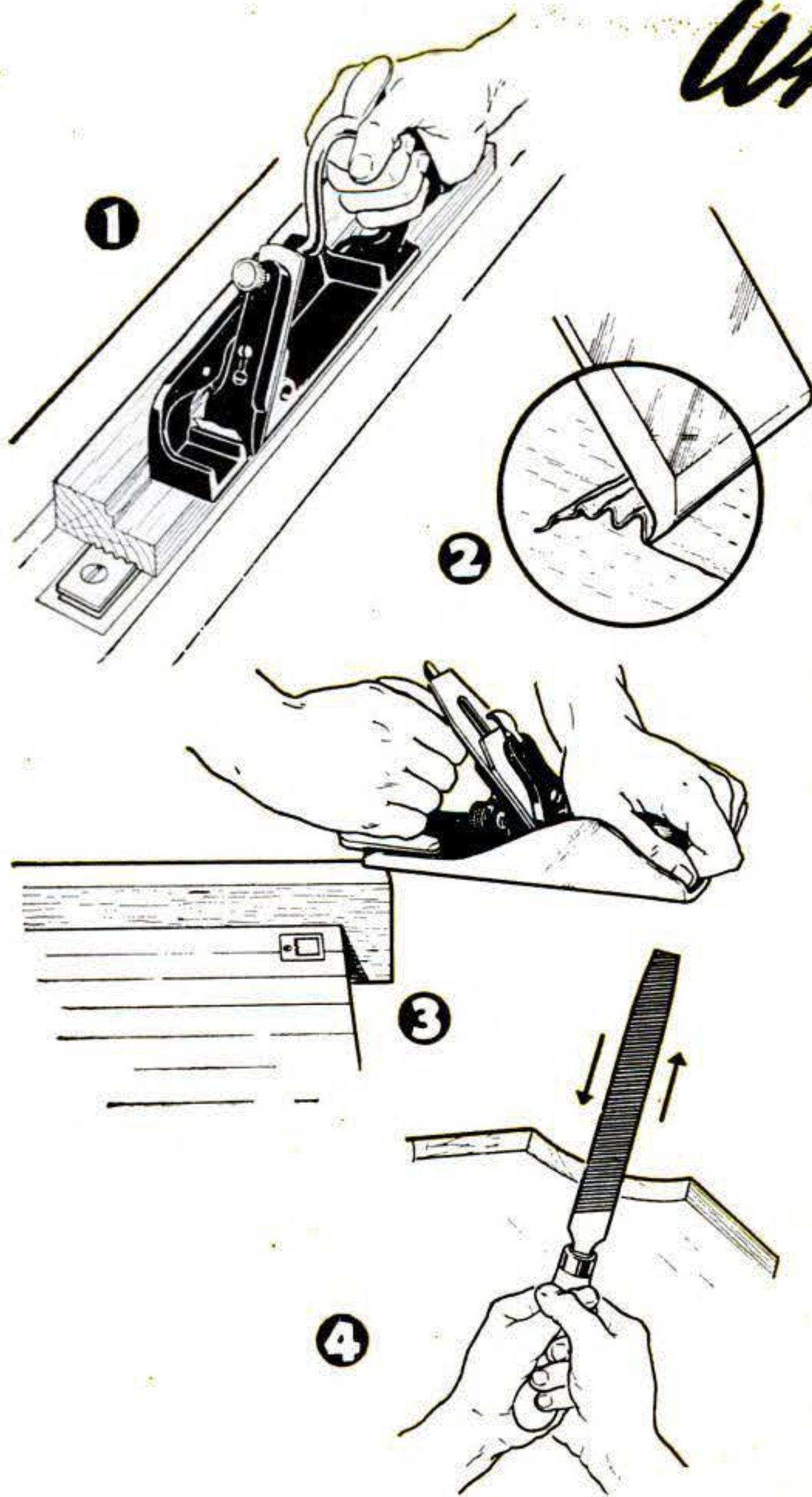
against the surface of the mortised part.

How is a dovetail half lap made? It is made like any half or cross-lap joint, except that the tenon is beveled back toward its shoulders to prevent it from pulling out of the mortise. In ripping the edges of the tenon, undercut them slightly to secure a wedging action when forcing the tenon into the mortise. This is a rigid joint that takes practically all of the load, the glue serving mainly to keep the tenon from lifting out.

How is a drawbolt joint made? When a rail is to be joined to a bench leg, gauge center lines on the sides and ends and locate the bolthole center on the leg. Square the

center line around the leg to permit boring from both sides. Bore a side hole in the rail just deep enough to permit the turning on of the nut, and chisel flat that side of the hole where the nut and washer will be seated. Assemble the joint by passing a carriage bolt through the leg and into the stretcher far enough to allow the washer to be slipped over the end. Add the nut, run it up with the fingers, and tighten it by driving the corner with a hammer and nail set. A dowel can be used in the joint to keep the rail from turning. The closed end of the hole for the nut may be turned outward or upward to hide the bolt.

What's Wrong?



CAN you find the errors being made in the woodworking operations shown at the left? They are: (1) planing a rabbet; (2) scraping veneered work; (3) jointing a straightedge; and (4) filing a curve on a shelf. The answers appear upside down below.

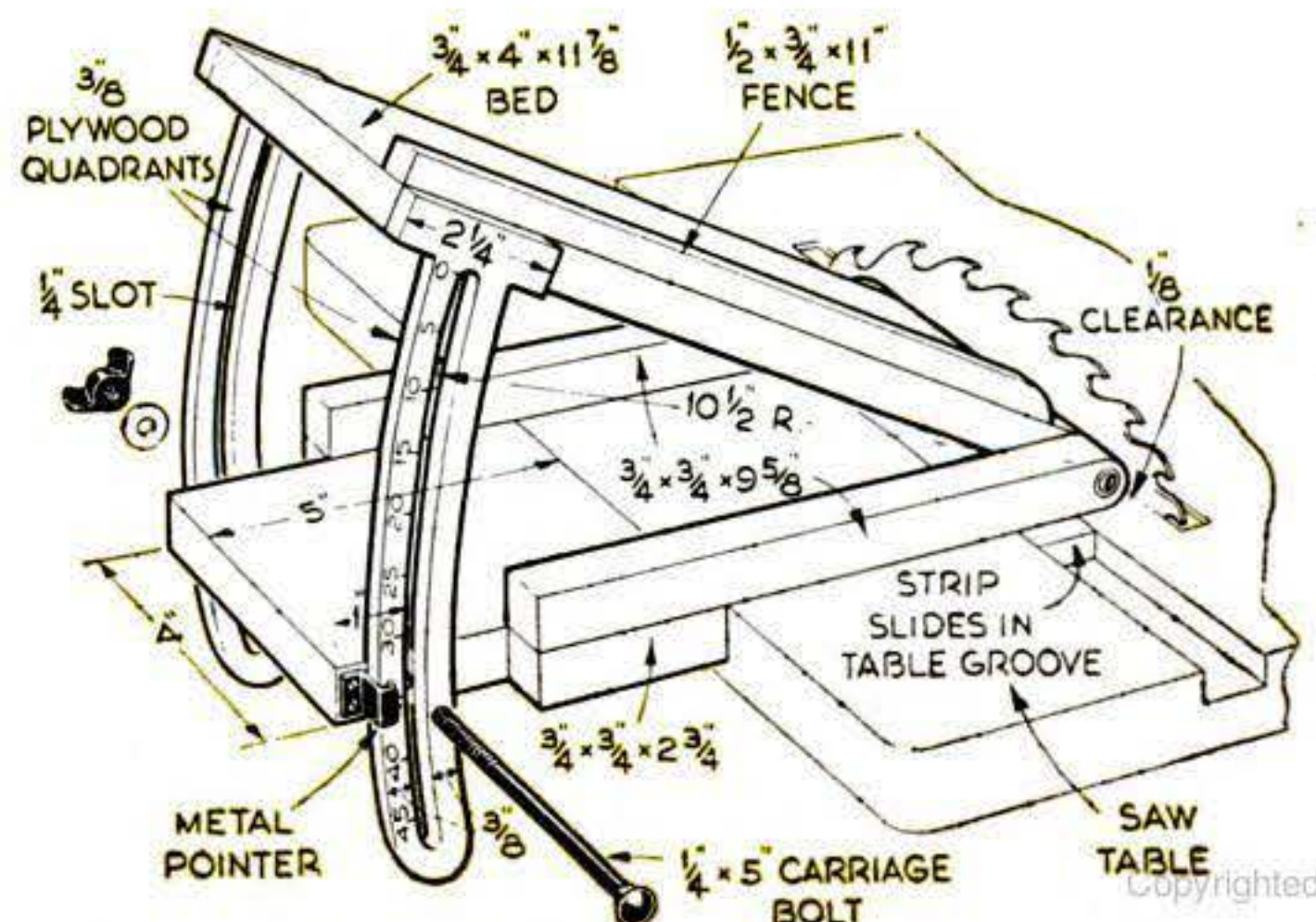
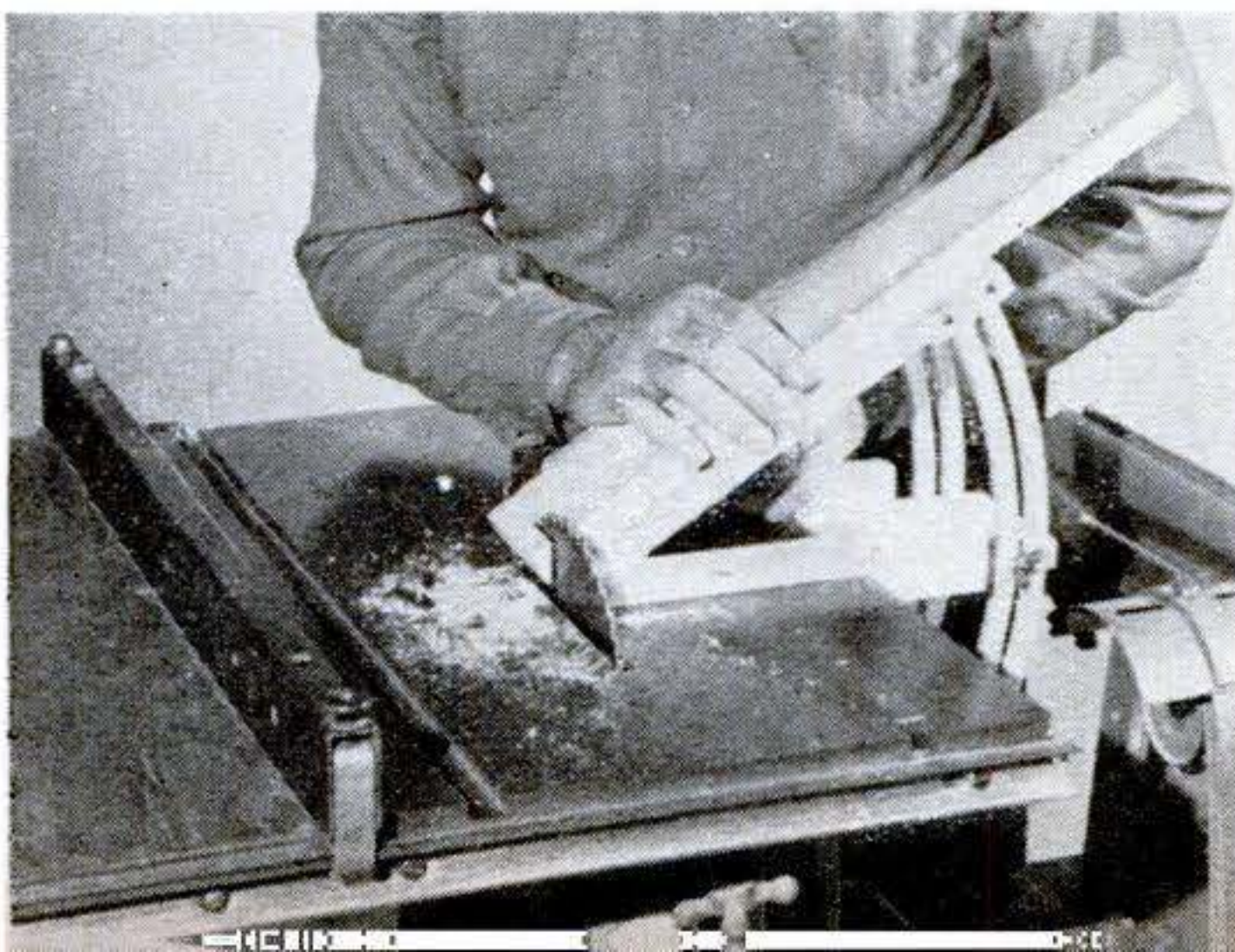
1. In cutting this rabbet, the plane itself should be guided by its fence or by a strip of wood secured to the work. 2. Chisel-edged scrapers tend to leave creases. On veneered or fine-surfaced work, use a square-edged scraper. 3. A jointer plane should be used for straightening an edge because its long sole bridges the high spots and it works them down. Every plane should be picked up at the end of a stroke to avoid dubbing off the end of the work. 4. A cabinet file is properly held with the handle in one hand and the end between the thumb and forefinger of the other. Instead of filing forward and backward in a straight line, thereby grooving the work, stroke forward and sideways with a rolling motion, distributing the cut over a large section of the curve. The file should also be lifted on the return stroke, which does not cut, but only tends to dull the teeth.

Adjustable Tilting Jig for Cutting Bevels on Circular Saw

RABBETED, locked, or splined miter joints can be cut on non-tilting circular saws with the aid of the simple jig shown in the photo and drawing below. Used with an 8" blade, the jig will permit handling stock up to 1½" thick. Work up to 4" wide may be held by hand, but it is advisable to clamp a wider piece to the bed of the jig.

The dimensions given are for a jig used

on a saw with the blade 7" from the left edge of the table, and they provide for a ⅛" clearance between jig and blade. For other saws, the length of the arms and bed must be changed. Both of these pieces are rounded at the pivot end. Make the curved adjustment arms of plywood and provide a metal pointer to indicate tilt. Apply linseed oil to prevent warping.—F. H.



S.S. Patrick Henry,

Our First Liberty Ship

CARGO VESSEL THAT LED THE WAY IN BREAKING THE U-BOAT BLOCKADE OFFERS APPEALING SUBJECT FOR MODEL BUILDERS

By Theodore Gommi

AS APPEALING a subject for model builders as any is this first of the Liberty ships to defy the U-boat packs of the North Atlantic. The accompanying drawings follow the basic plans upon which the 10,000-ton *Patrick Henry* was built. More recent Liberty ships have been modified, but the hull lines and the general appearance of the superstructure are unchanged. And since ease and speed of construction were essential for the 441½' long prototype, details of the model were conceived in the same vein.

Only wood, paper, paint, pins, wire, and other easily obtained materials are required, and the usual household tools will suffice. Start by cutting the materials to the specified sizes and shape all flat pieces to the lines in the drawings. Plane and sandpaper the top of the hull block A to the proper sheer, and then shape the ends. The cross-section drawings and the dotted lines in the plan will be sufficient guide.

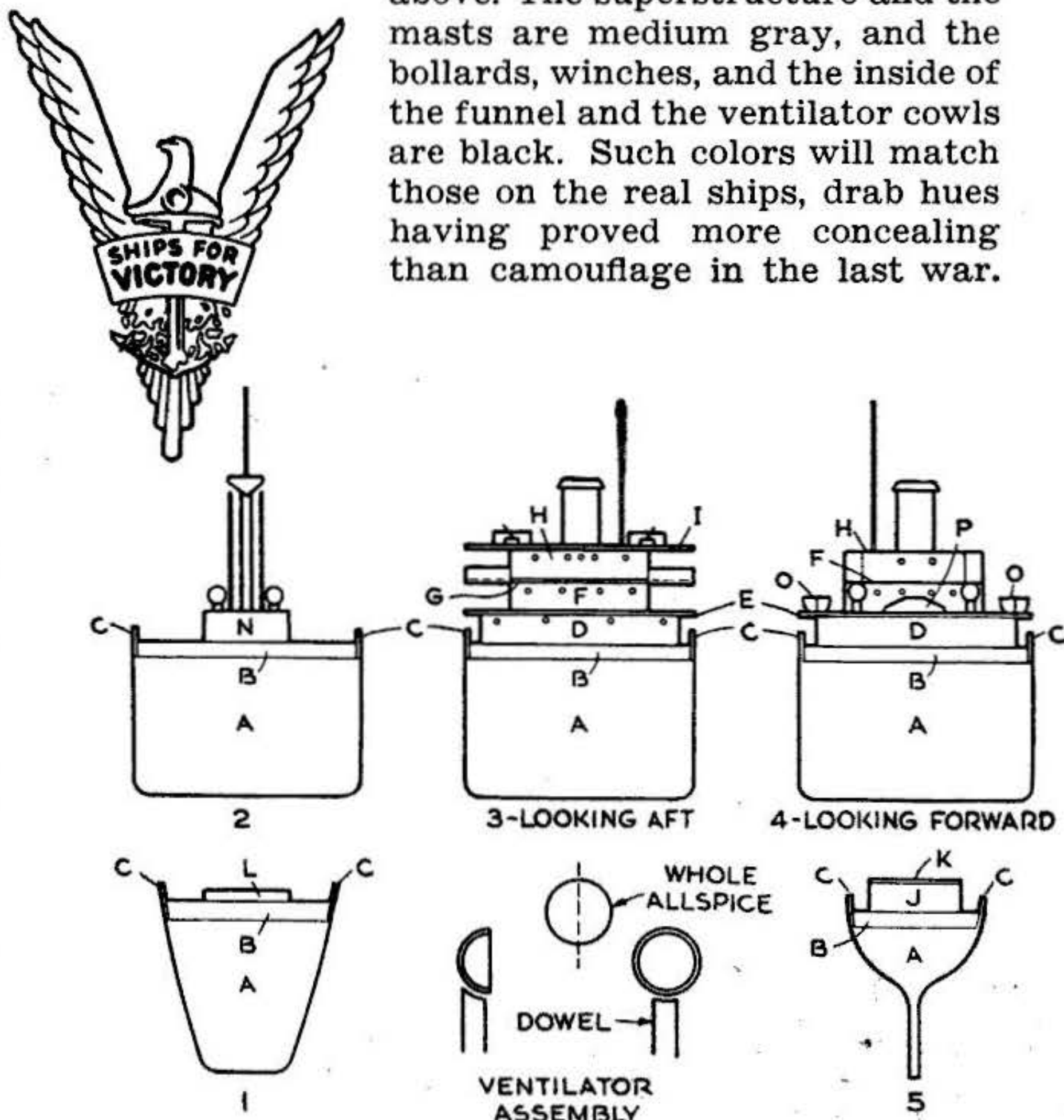
Cut B to the exact shape of the top surface of A, and reduce the width by sandpapering off 1/32" along each side to allow for the thickness of the bulwark C. Fasten B to A so that this margin is even all around, except at the very stern where B comes to the edge. Shape the bulwarks C so that they fit snugly in the rabbet formed by A and B, and shape the lower edge to match the top edge of A. Then cut the top edge parallel. The width is exactly 1/4" for the entire length. Glue C to A and B. If the wood is too stiff to hold a curve, soak it in boiling water and then bend it. The perforations can then be drilled. Two or three holes are drilled in a row for the slots, and excess wood is removed.

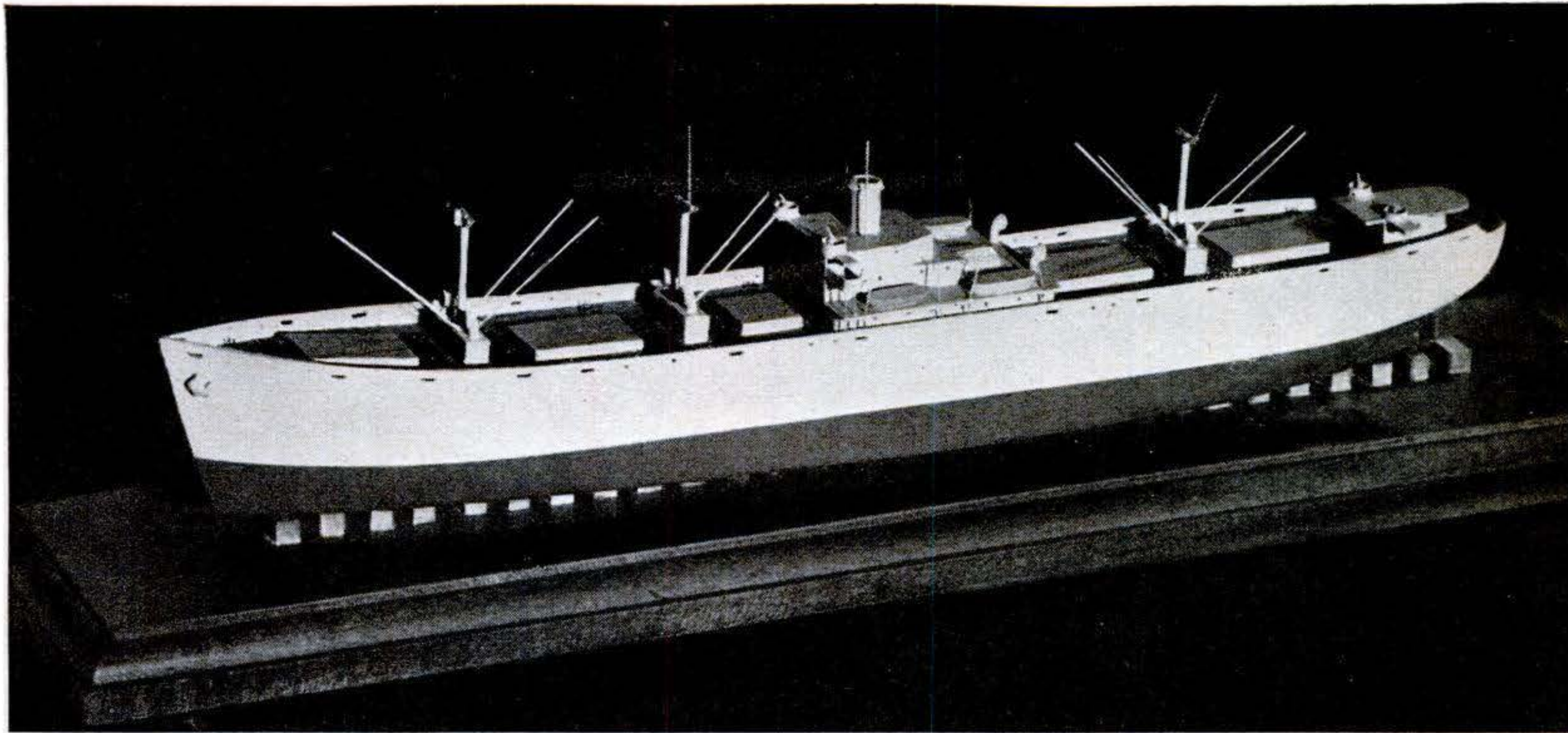
For the superstructure, rabbet the underside of H to hold G. Port-holes are drilled in D, F, and H. Thin strips of paper protect the gun platforms and serve for bridge and stair rail. Masts are inserted into

the mast houses N, as are the wire booms, which are then bent to proper angles. Each unit is glued to the hull after it has been painted. Ventilators may be made by cutting whole allspice in half, removing the centers, and mounting the half shells on bits of tooth picks, or metal ventilators may be used.

For the bollards, glue small pieces of black paper to the deck and drive two short pieces of wire through the paper into the hull. To make a winch, slip two small eyelets over wire to form the drum and fasten it to a square of black paper. Lengths of wire are inserted through small beads for guns. The anchor and screw are heavy cardboard.

The main deck of the vessel is painted a dull red. Dark gray is used on the hull below the waterline, and a medium gray above. The superstructure and the masts are medium gray, and the bollards, winches, and the inside of the funnel and the ventilator cowls are black. Such colors will match those on the real ships, drab hues having proved more concealing than camouflage in the last war.



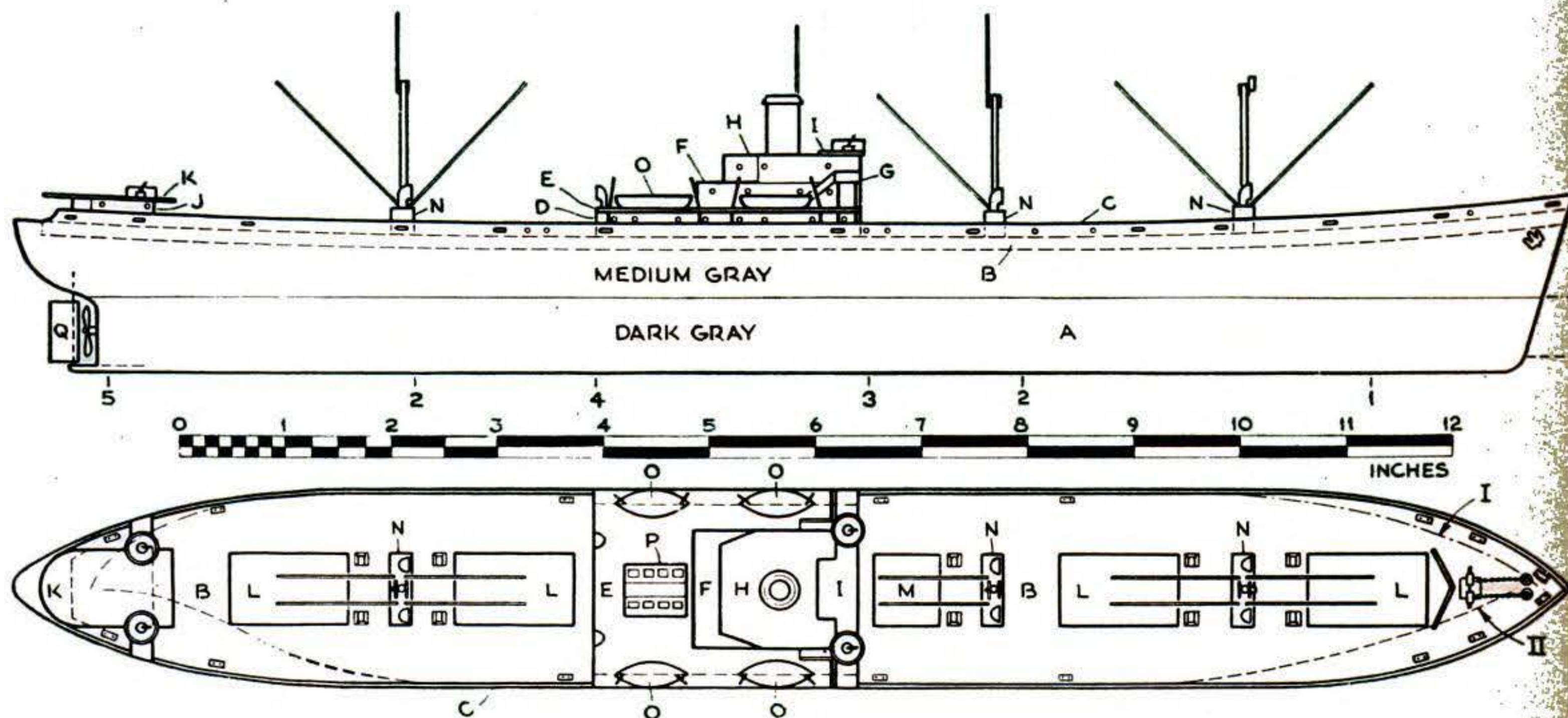


LIST OF MATERIALS

No. Pc.	Material Pine, bass, or balsa	T	W	L	For	No. Pc.	Material Pine, bass, or balsa	T	W	L	For
1	"	1 1/2	1 7/8	14 3/4	A	1	"	1/4	3/4	3/4	J
1	"	1/8	1 7/8	14 3/4	B	1	"	1/32	3/4	1 1/4	K
2	"	1/32	3/4	14 1/2	C	4	"	1/16	11/16	1 1/8	L*
1	"	1/4	1 5/8	2 1/2	D*	1	"	1/16	11/16	5/8	M*
1	"	1/32	1 7/8	2 1/2	E*	3	"	3/16	1/4	11/16	N*
1	"	1/4	1 1/8	1 1/2	F*	4	"	1/8	1/4	3/4	O
1	"	1/32	1/4	1 7/8	G*	1	"	1/8	1/2	9/16	P
1	"	1/4	1 1/8	1 1/4	H	1	"	1/16	1/4	9/16	Q
1	"	1/16	3/8	1 7/8	I	1	"	1/16 round		6	Masts

NOTE: All dimensions are given in inches. Items marked with an asterisk need no further shaping after being cut to the dimensions given.

MISCELLANEOUS: 14 small eyelets for winches and hawse lips; 4 small beads for guns; 8 whole allspice for ventilator cowls; 1 piece of 5/16" tubing about 1/2" long for funnel; 3' thin, stiff wire for booms, bollards, davits, and guns; 2" thin chain; 1 small piece of bristol board; 1 small piece of black paper; and dark-gray, medium-gray, and dark-red paint.





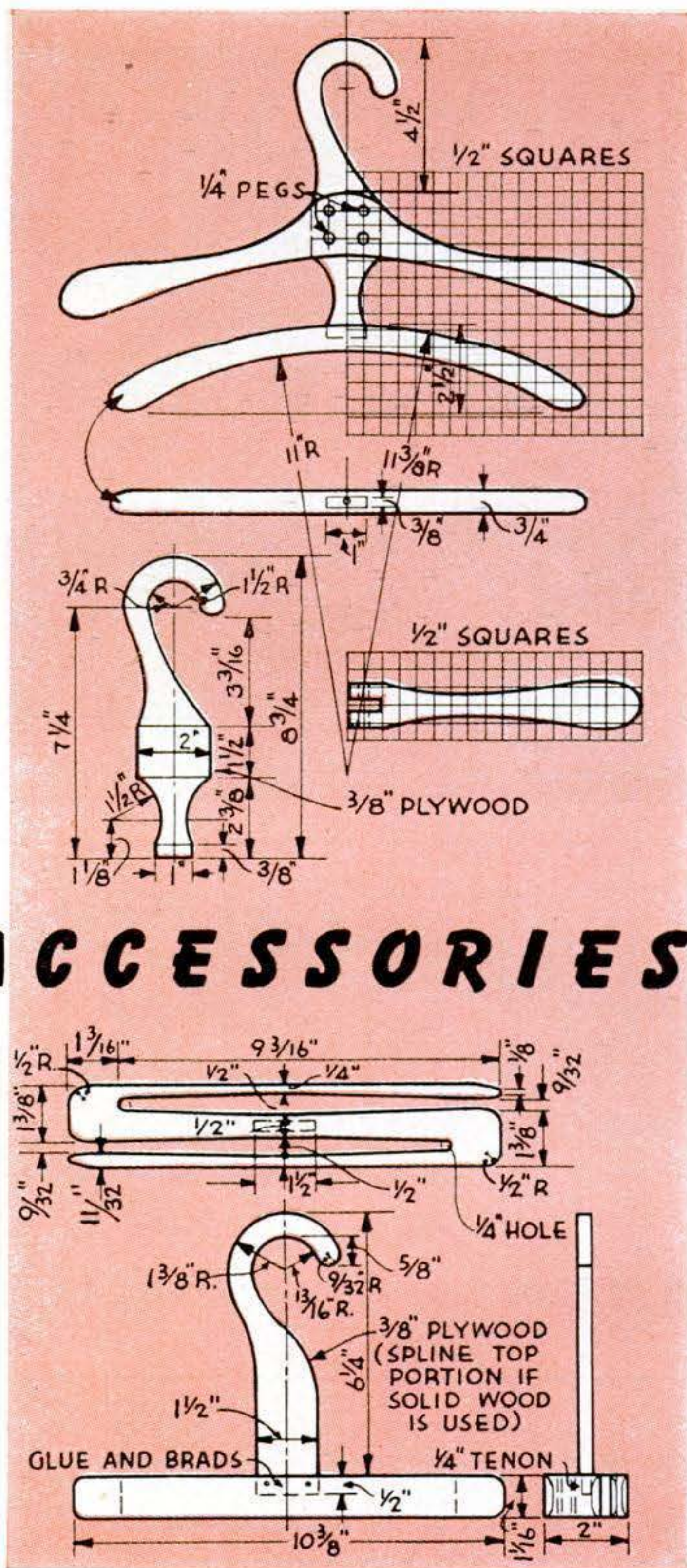
Two-IN-ONE WARDROBE ACCESSORIES

Designed by ERNEST R. DEWALT

THESE unique clothes hangers are so sleek of line that they disguise much of the sturdy workmanship built into them. One hanger will take two coats and vests, and the other two pairs of trousers. Used by a woman, the hangers will accommodate slacks and a jacket and skirt or a dress and slip.

DOUBLE-DECK HANGER. Maple, birch, or cherry will make a handsome hanger, though any strong wood will do. Bandsaw the arms, following the profile drawing for the top one. It is preferable to jigsaw the hook from $\frac{3}{8}$ " plywood, but solid wood can be used if the part is splined across the top for strength. The inside of the hook should be cut on a $\frac{3}{4}$ " radius in order to clear a closet pole easily. Fit the halves of the top arm over the hook and drill for $\frac{1}{4}$ " dowels. The bottom hanger may be wider near the shoulders to prevent slipping of a garment. This part is smoothed and sanded after it is bandsawed and mortised for the shank of the hook. Round all the sharp edges.

Assemble the halves of the top arm by gluing them on the hook and doweling. Glue the bottom arm in place and further secure it with a flathead screw put through a hole drilled slightly undersize and countersunk. Finish the piece with two coats of varnish thoroughly rubbed between coats. Working time, 4 hours.



TWIN TROUSER CLIP. Two pairs of trousers, slipped into the forks and held by the cuffs, can be hung on this rack to occupy little closet space. Cuffless trousers can be draped over the forks. To make the clip, first bandsaw the S-shaped part, adhering to the drawing for such details as the opening, the widened middle portion of the slot (where seams would make the trousers thickest), and the wall thickness for strength. Bore the holes and bandsaw this part, sanding inside walls and softening all edges. Round the ends and corners as indicated in the photo and drawing. Chisel out a mortise for a plywood hook made the same way as that for the companion piece, assemble the two parts with glue, and clinch with two brads. Working time, $3\frac{1}{2}$ hours.



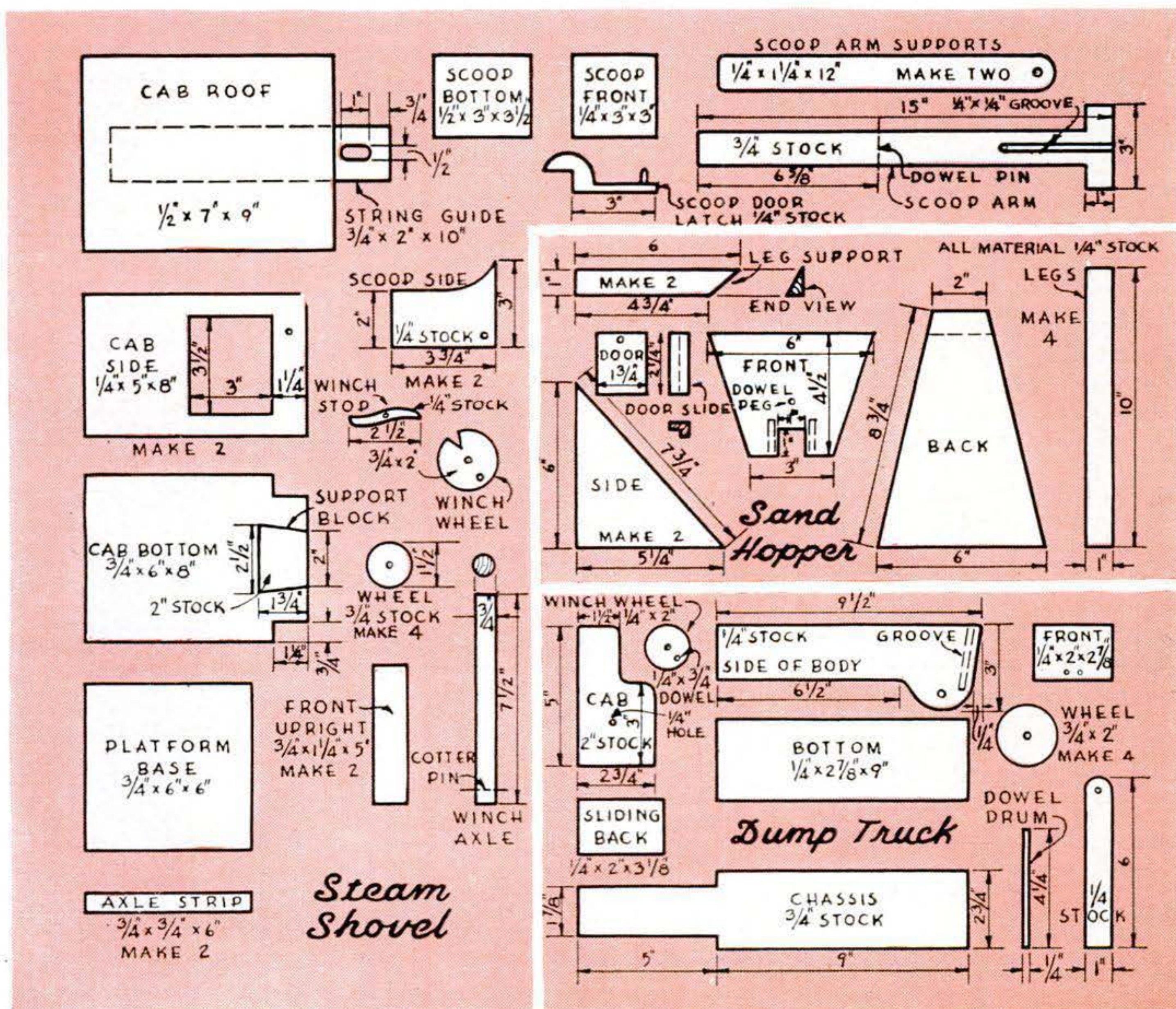
Sturdy Toy Machinery for Sand Piles Will Gladden Young Engineers

THIS toy contractor's set actually works, and its movable parts are easy to make. Pivot the power-shovel cab on the platform with a flathead screw and the wheels on fixed axles. The scoop arm swings on a dowel pin between the two supports. Hinge

the bottom of the scoop at the outer end with nails run through holes drilled in the sides. A groove in the scoop arm contains a sliding latch which is prevented from falling out by a small wooden crosspiece. For lifting, a cord is fastened to the arm, passed through a guide slot, and threaded through a hole in a dowel that forms the drum of the winch, which is fitted with a notch and pawl.

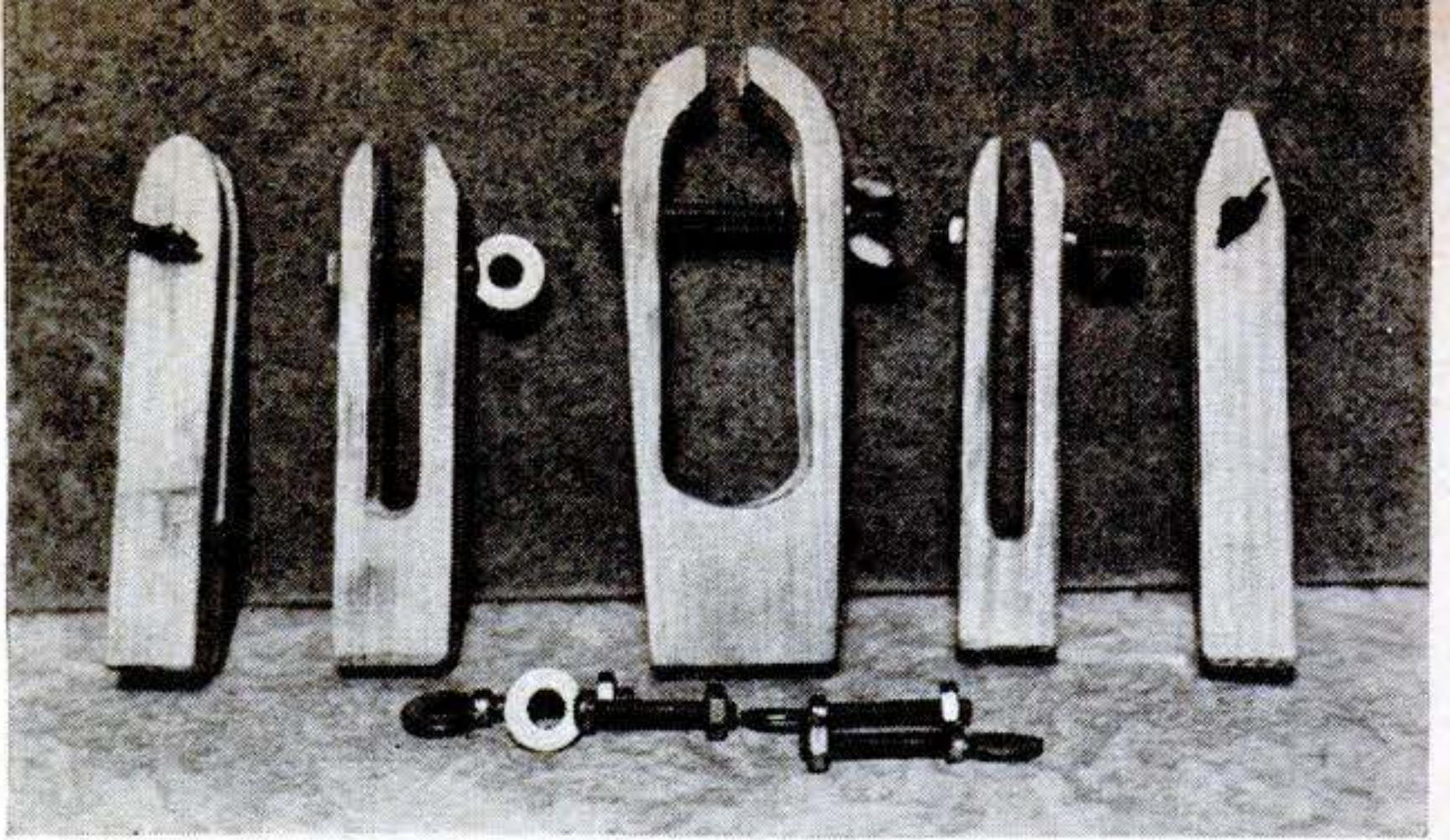
The door of the hopper is pushed up by sliding it along two grooved guides. Set a dowel peg for a doorstop.

Hinge the tilting body of the dump truck by running the rear axle screw through holes bored in the dropped sides. Attach the center of a short length of cord to the body, run the ends over the elevated bar and through two holes drilled in the winch axle near the sides of the cab, and tie them fast.—ELMA WALTNER.



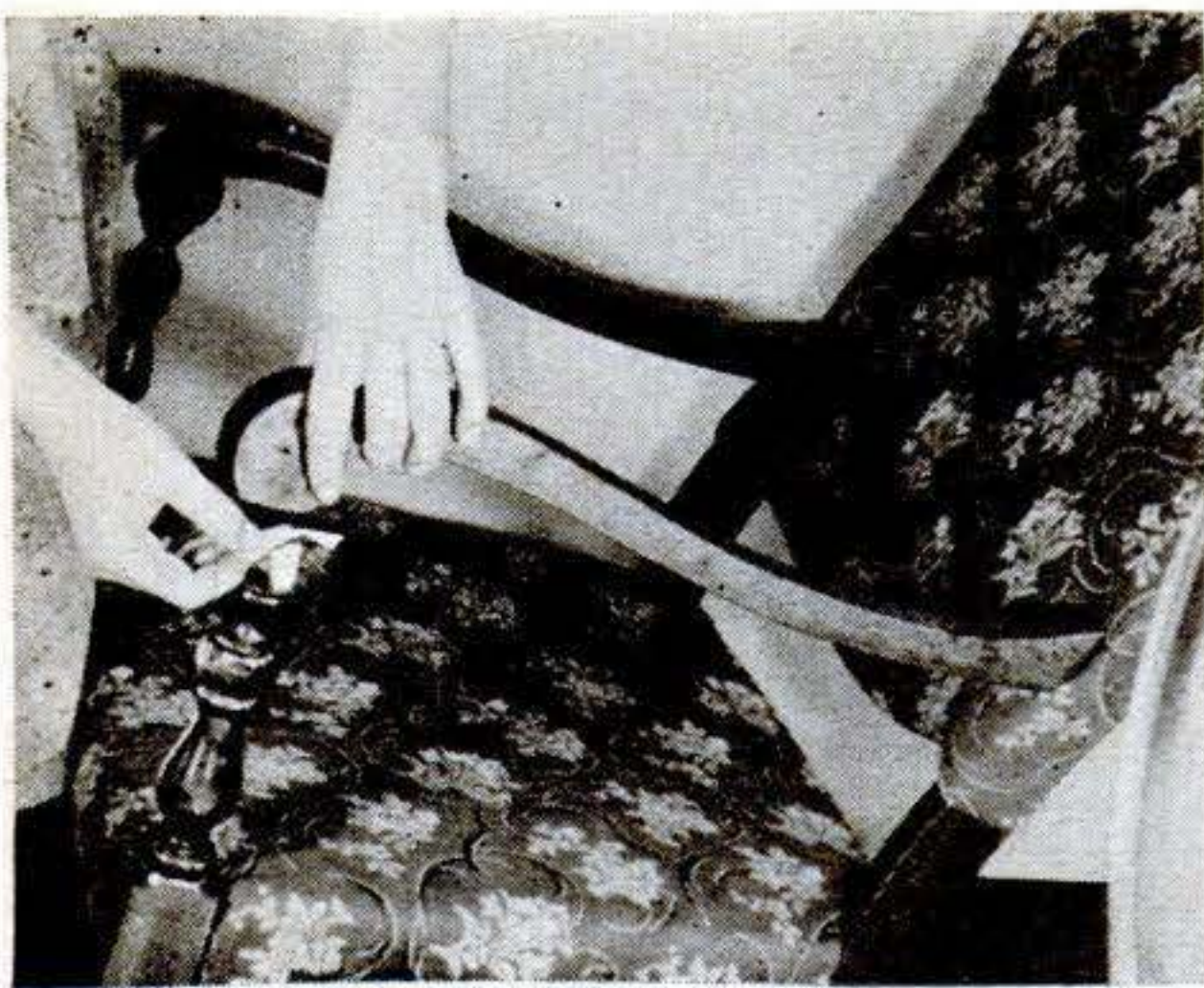
Variety of Clamps Sawed from Scrap Pieces of Oak

WOODEN clamps served the purpose of one craftsman who did not have enough metal ones for the job. They were made from scraps of $\frac{5}{8}$ " oak, some machine screws, and a few washers. A coping saw was used to cut the body of the clamps, and No. 10-24 fillister-head machine screws were employed in lieu of the ordinary thumbscrews. To provide thumb-nuts for these screws, a simple but ingenious expedient was resorted to. A small washer was merely soldered into the slot in the



head of each screw. The clamps shown were used successfully in the delicate work of cementing a large quantity of lapping stones in their metal holders. They can be made in almost any size.—DICK HUTCHINSON.

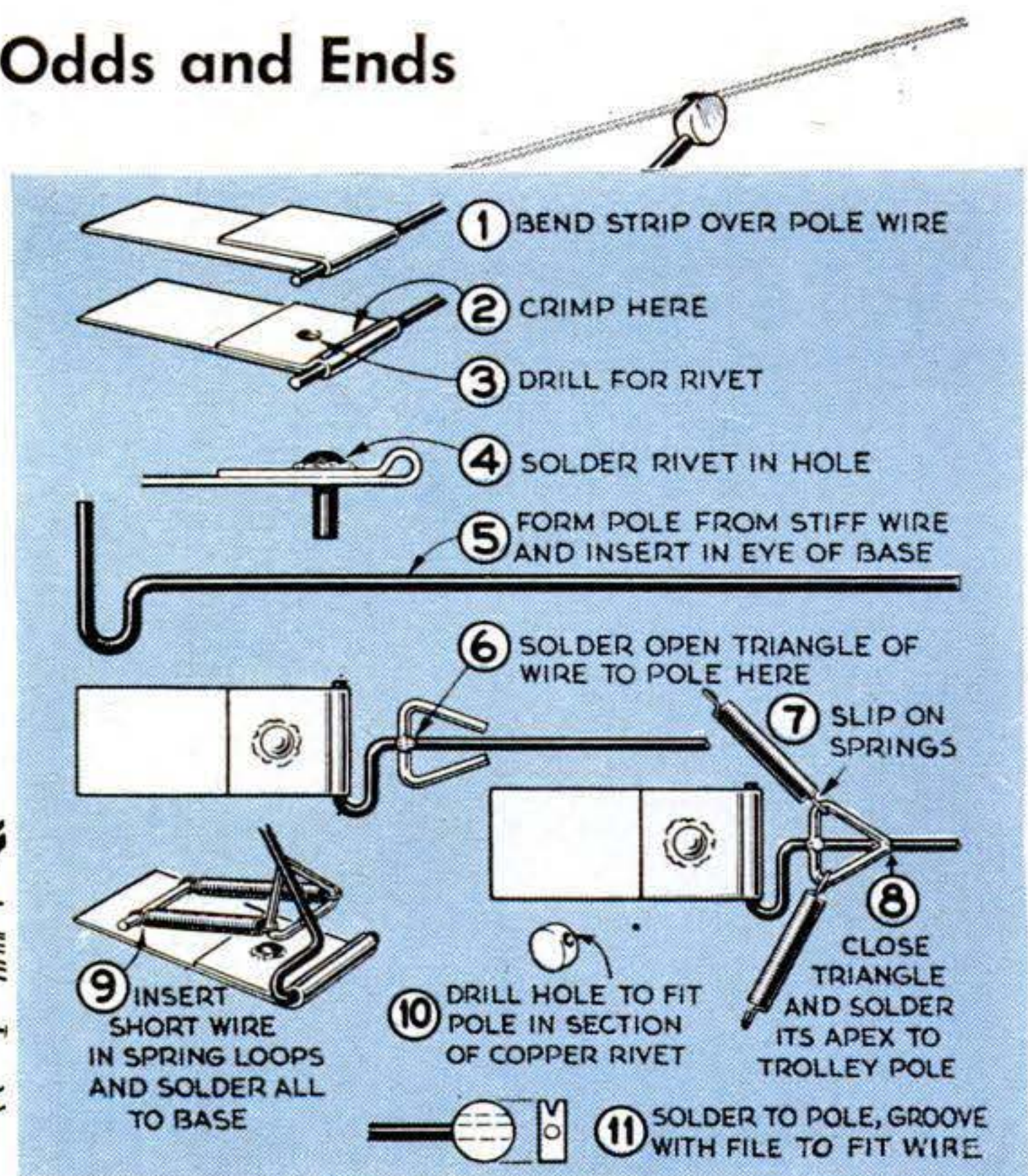
Cleaning of Loose Joints Assures Firm Grip for Fresh Glue



NEGLECTING loose joints in chairs is generally to invite the eventual breaking of the end of an arm or a stretcher that is not loose. Loose joints should be repaired promptly, but prompt action will mean little unless the joints are thoroughly cleaned of old, dried-out glue before fresh glue is applied. It is important to remove hard glue from the hole as well as from the peg of a joint. This can be done with sandpaper wrapped around a pencil. If the sanding of both hole and peg leaves the joint loose-fitting, spread glue around the peg and lay two cloth strips on it crosswise as shown at the left; then daub glue in the hole and press the arm in place. For a very loose joint, use a disk of cloth in the same way.

Model Trolley Pole Is Made of Odds and Ends

DRAWINGS at the right show how a home craftsman can fabricate an efficient model trolley pole from a few lengths of stiff wire and some odd bits of copper and brass. Designed for an HO-gauge line, the pole was equipped with coil springs made by winding piano wire around a piece of $\frac{1}{16}$ " wire chucked in a hand drill held in a vise. The base was made by doubling a strip of brass around the length of bronze wire used for the pole. A pin through the car top served as the pivot. The trolley shoe was made of a rivet grooved with a file.—WILLIAM SCHOPP.



Old Spark Coil Lights Welding Torch

SPEEDY and convenient, this automatic lighter for a gas brazing or welding torch makes a handy shop accessory. When you touch the torch tip against a washer at the top of the lighter, a fat spark promptly ignites the gas stream. The device is built of commonly available parts and takes but little time to assemble. A doorbell transformer, its primary or secondary circuit completed by a homemade switch, supplies current to an old vibrator-type auto spark coil. The high-voltage output is fed to a spark plug mounted so that its points extend slightly from the box which houses the lighter.

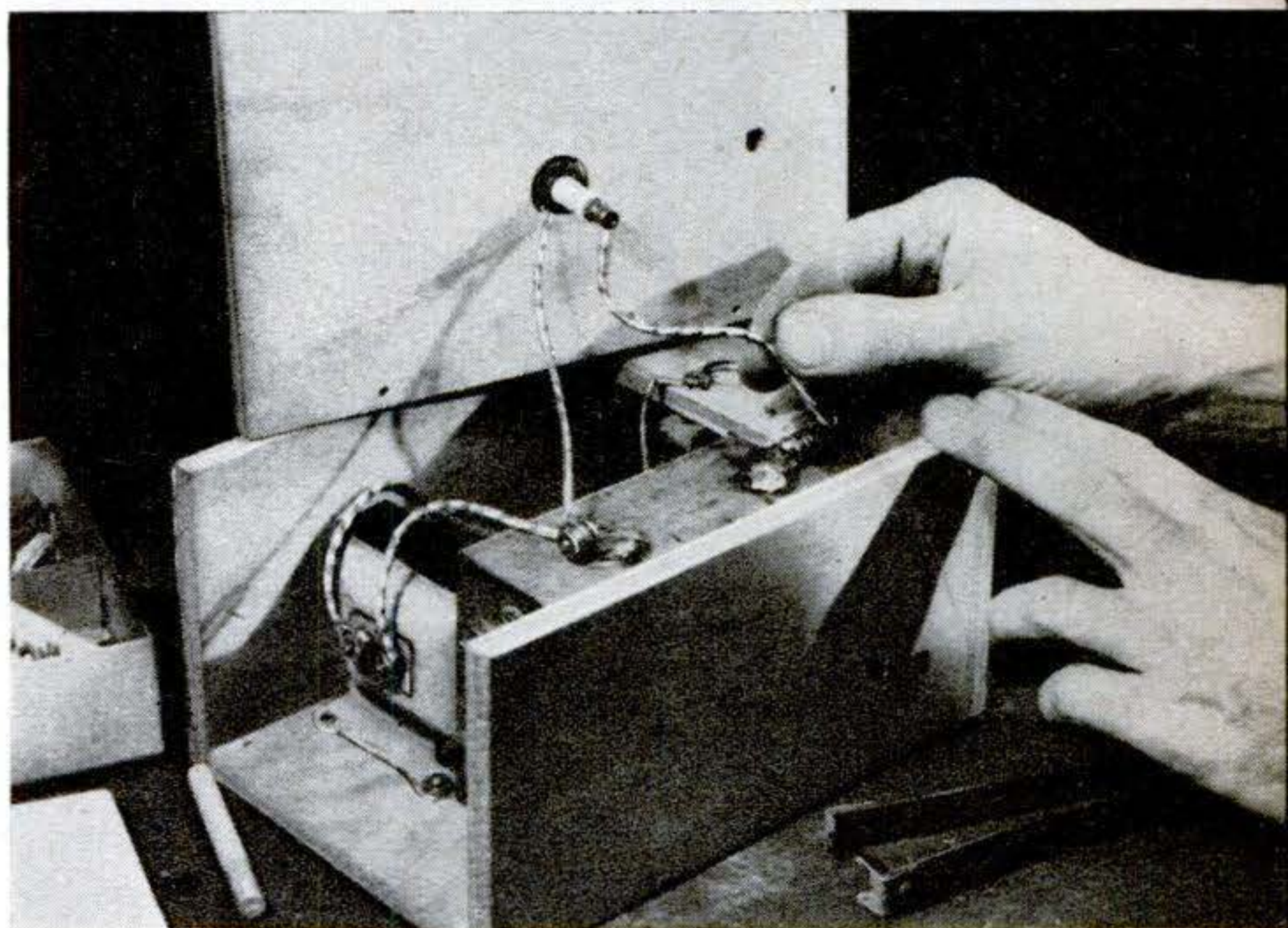
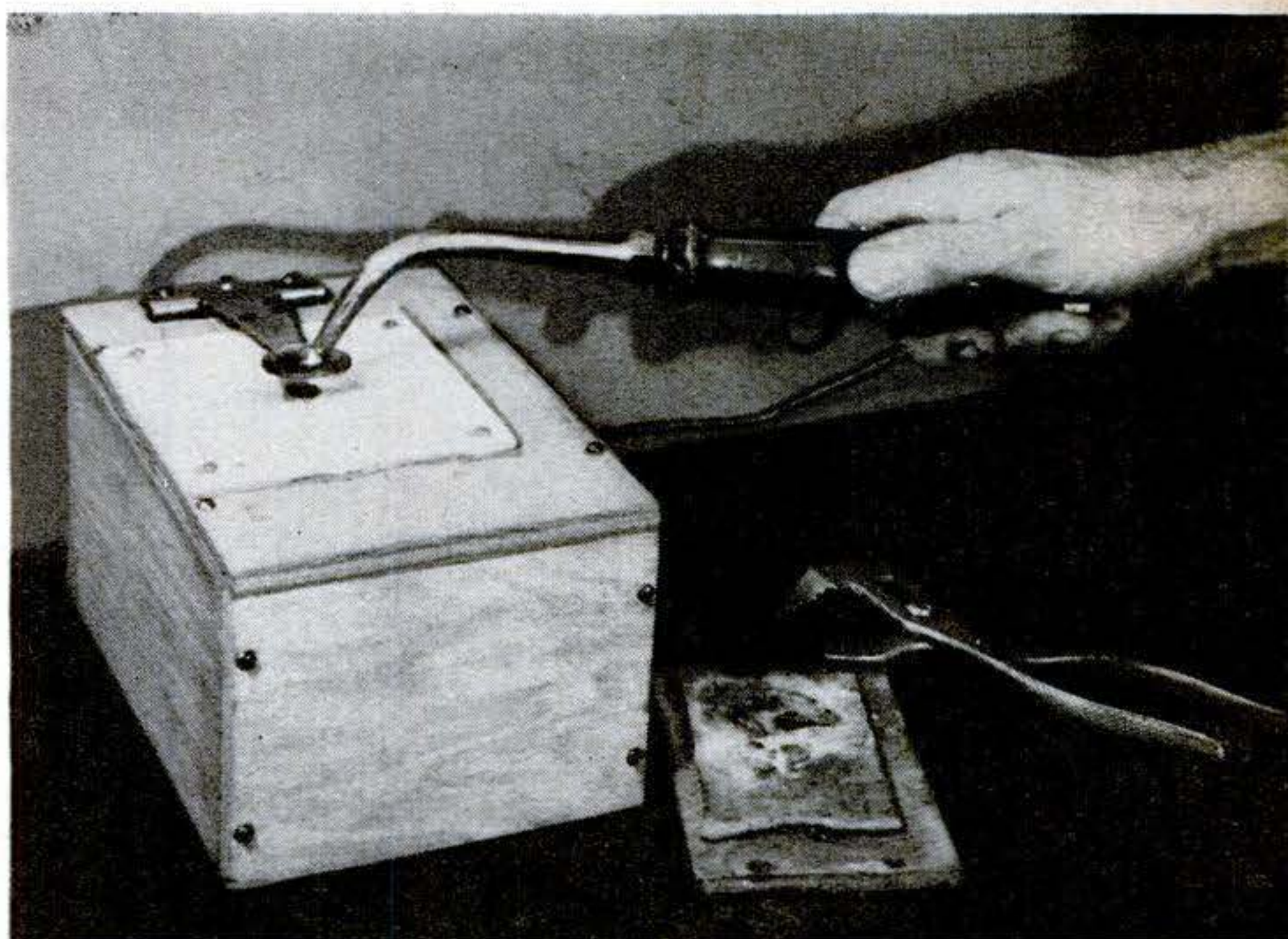
Construct the box of $\frac{3}{8}$ " plywood, dimensioned to fit the coil and transformer you use. The box shown measures $4\frac{3}{4}$ " by $5\frac{5}{8}$ " by $8\frac{1}{2}$ " on the outside. To facilitate any adjustment of the vibrator or switch, make the top and one end of the box readily removable. Near the center of the top, drill a hole into which a spark plug can be screwed until its points protrude about $\frac{1}{8}$ ".

The switch required is one which will close the circuit whenever a dowel button is lightly pressed. Two strips of springy brass, shaped as indicated, are bolted to an insulating block—in this case a ceramic part salvaged from an electric stove—and mounted on a wooden support attached to a wall of the box. The switch is located directly beneath a second hole in the cover, and a length of dowel serves as a button, being depressed by the free leaf of a T-hinge on the cover.

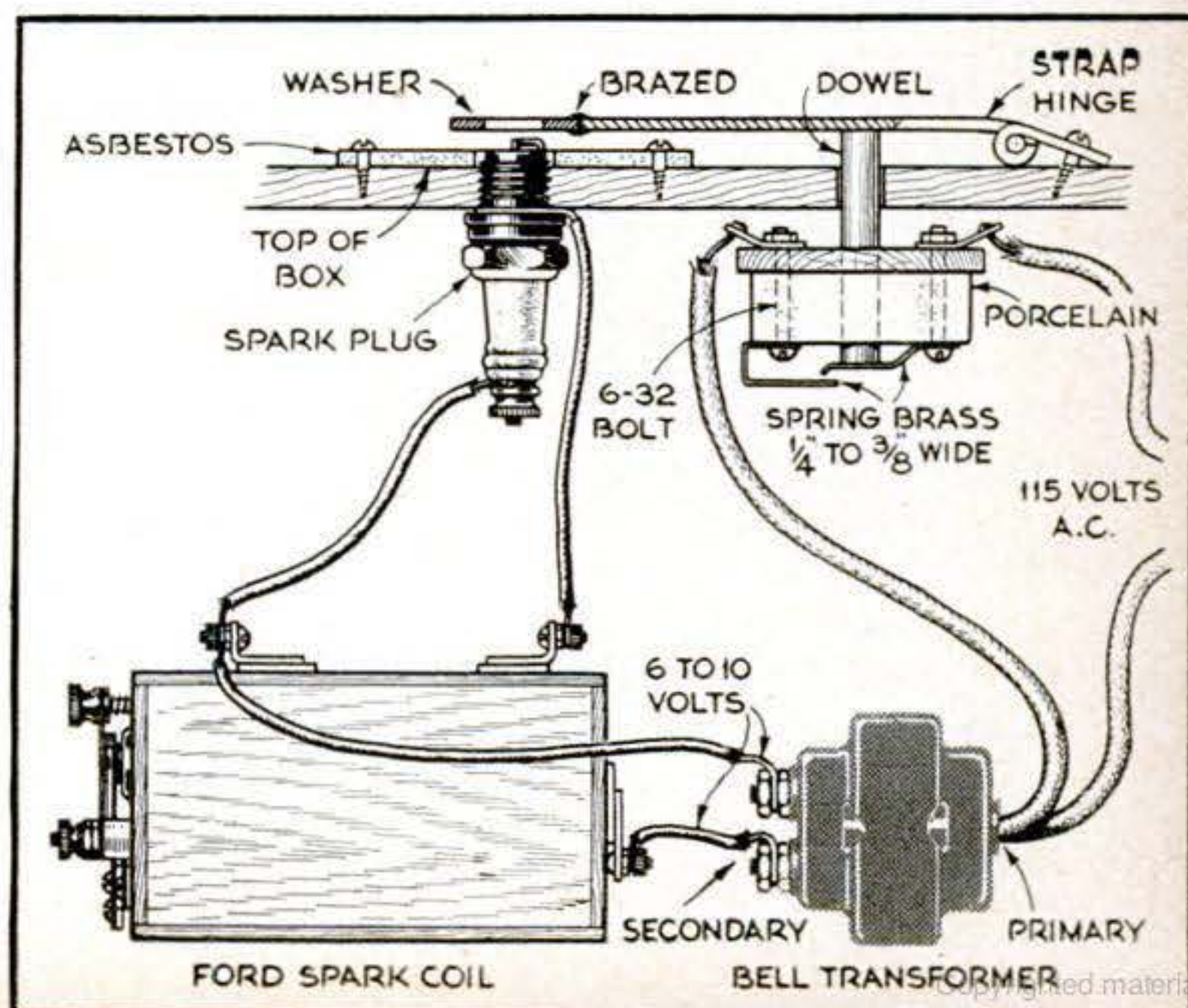
Before attaching the hinge, weld or braze a steel washer to the tip of the long leaf, where it serves as a ring for the torch tip. Mount the hinge so that this washer is directly over the spark-plug points, and cut the dowel at a length which will permit the washer to be about $\frac{1}{4}$ " from the points when the switch is fully depressed. A 4" square of asbestos roofing or other fire-resistant material is secured to the cover for protection against heat from the torch.

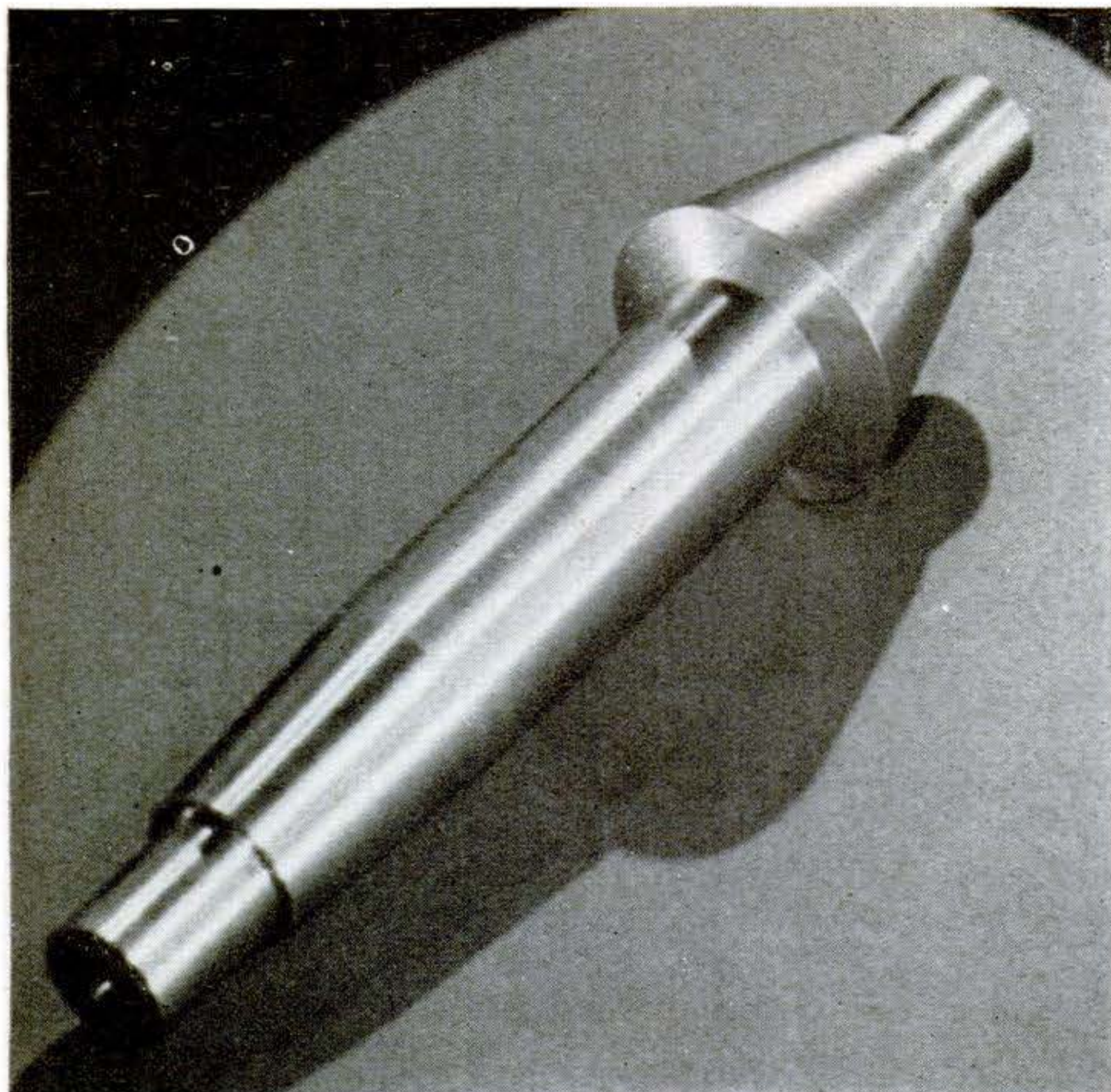
To light the torch, turn on the gas and depress the washer with the torch tip. A brief tap, producing a spark that lasts but a fraction of a second, is generally all that is needed.—W. E. B.

FEBRUARY, 1944



When an unlighted gas torch is tapped against this automatic lighter, a spark ignites it with a pop. The doorbell transformer, coil, and spark plug are shown in the photo just above; below is the circuit





**PARTS THAT MUST
FIT ACCURATELY
OFTEN CALL FOR
TURNED TAPERS.
PICTURES ON THE
FOLLOWING PAGES
SHOW THIS LATHE
JOB IN EASY-TO-
UNDERSTAND STEPS**

Turning Tapers on the Lathe

LATHE centers are a familiar example of taper fits, which are useful whenever parts must fit together without play and in precise alignment. Such fits have the added advantage that they can readily be taken apart when necessary.

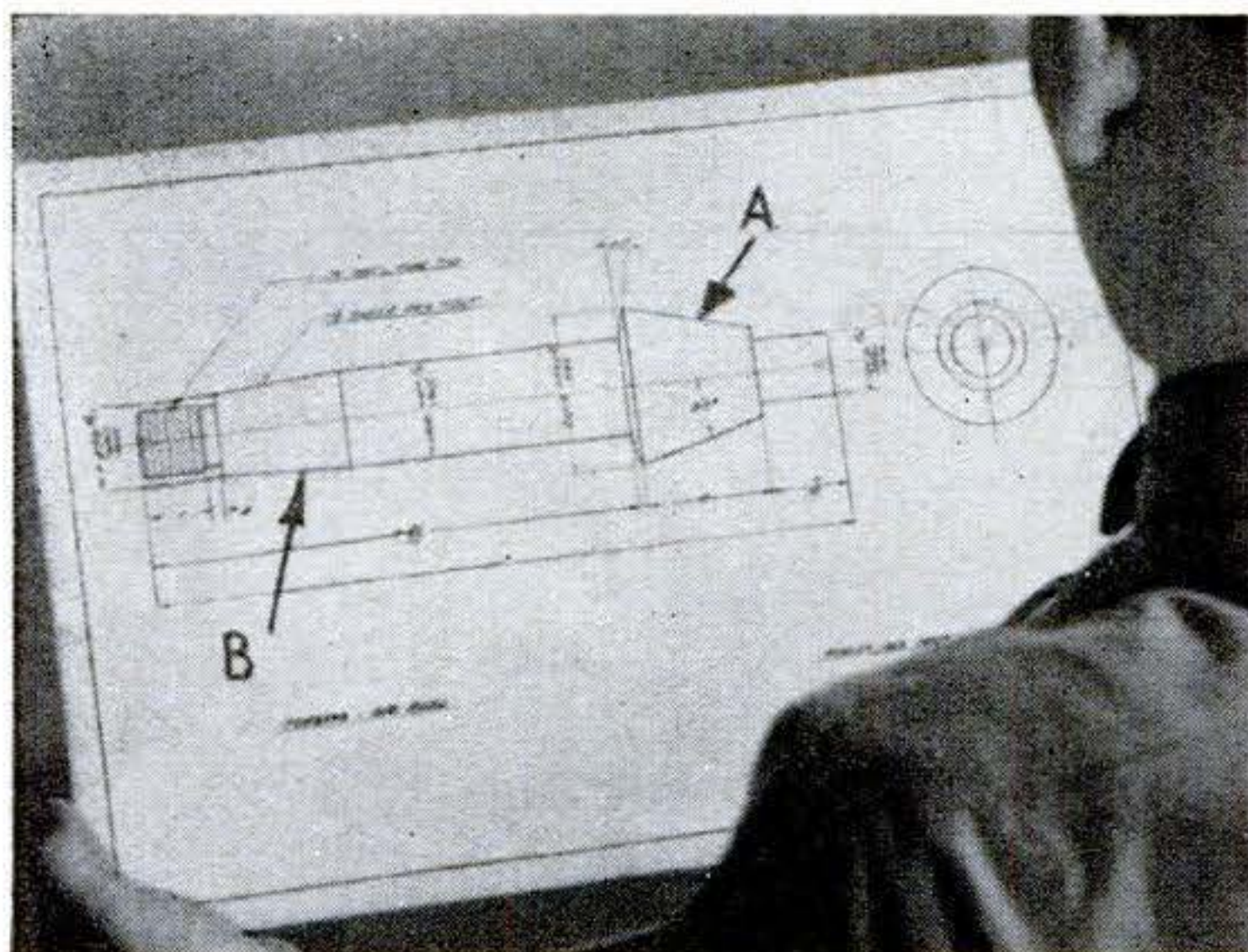
One way to turn external tapers on a lathe is to swivel the compound rest to the desired angle. As its travel is limited to a few inches, only short tapers can be turned in this way. The base of the compound rest is graduated in degrees, and when it is at zero on the scale, its center line is at 90 deg. to the lathe bed. When swung to 90 deg. on the scale, the compound rest is parallel to the center line of the lathe. Since tapers are usually expressed with relation to the center line of the work, it is from this point that the angle is reckoned in setting the rest.

The lathe carriage must not move while the cut is being made, for the tool must be advanced only along the line of the compound rest. The depth of cut is adjusted by setting the tool in with the cross-slide feed screw.

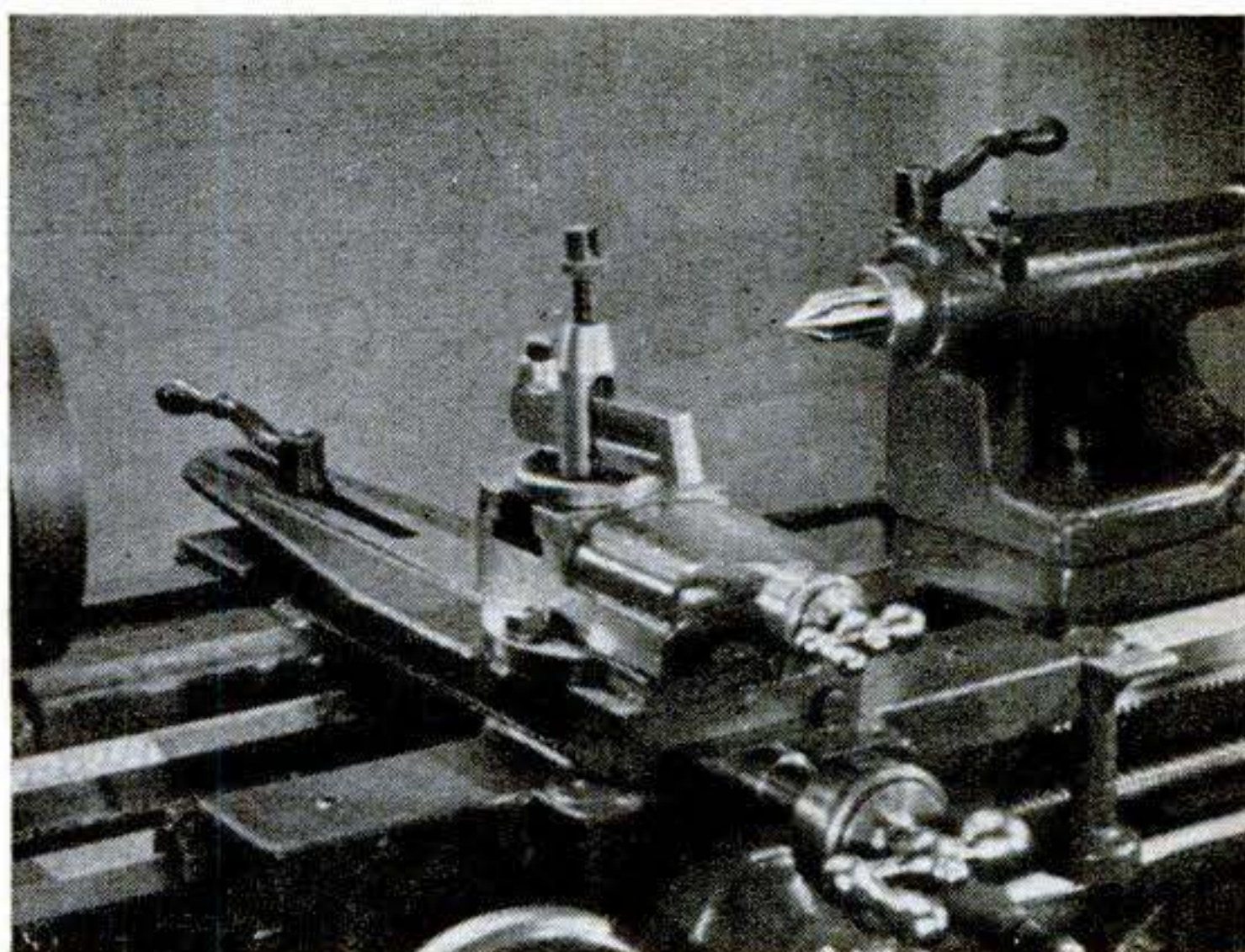
Tapers up to 3" per foot can be turned with the taper attachment. This clamps to the lathe bed and has an adjustable bar that can be locked at an angle to the bed. The length of the taper that can be cut is limited by the length of this bar. A shoe that slides along it is clamped to the cross slide, and the screw that ordinarily secures the cross slide to the feed-screw nut is removed so that crosswise movement of the slide is governed entirely by the shoe. When the carriage is moved along the lathe by the longitudinal feed, the tool follows a path that is parallel to the taper bar. In this case, the tool is advanced after each cut by the compound-rest feed.

In cutting tapers by either method, it is vital that the tool be set *exactly at center height*. If it is above or below, the taper will not be correct.

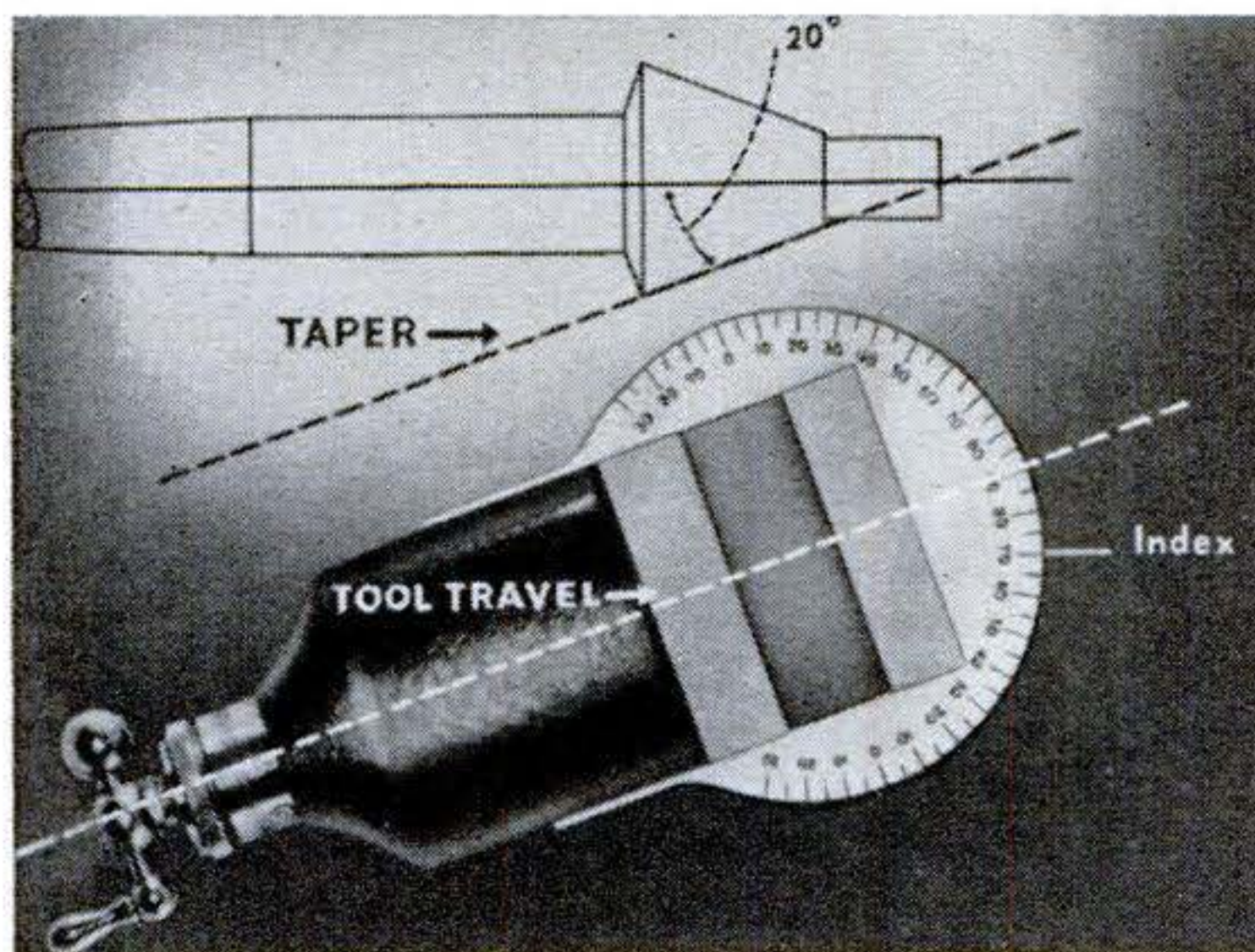
Pictures on the following pages show the turning of tapers with the compound rest and with the taper attachment. These photographs were made from a sound film released by the U. S. Office of Education and distributed by Castle Films.



1 Two tapers are specified on this drawing of a small shaft. The short, relatively steep one at A can be cut by means of the compound rest, while that at B will be made with the taper attachment



2 The compound rest can be swiveled on the cross slide and locked at any angle. At zero on the scale, its feed screw is parallel to that of the cross slide and at 90 deg. to the spindle, as above



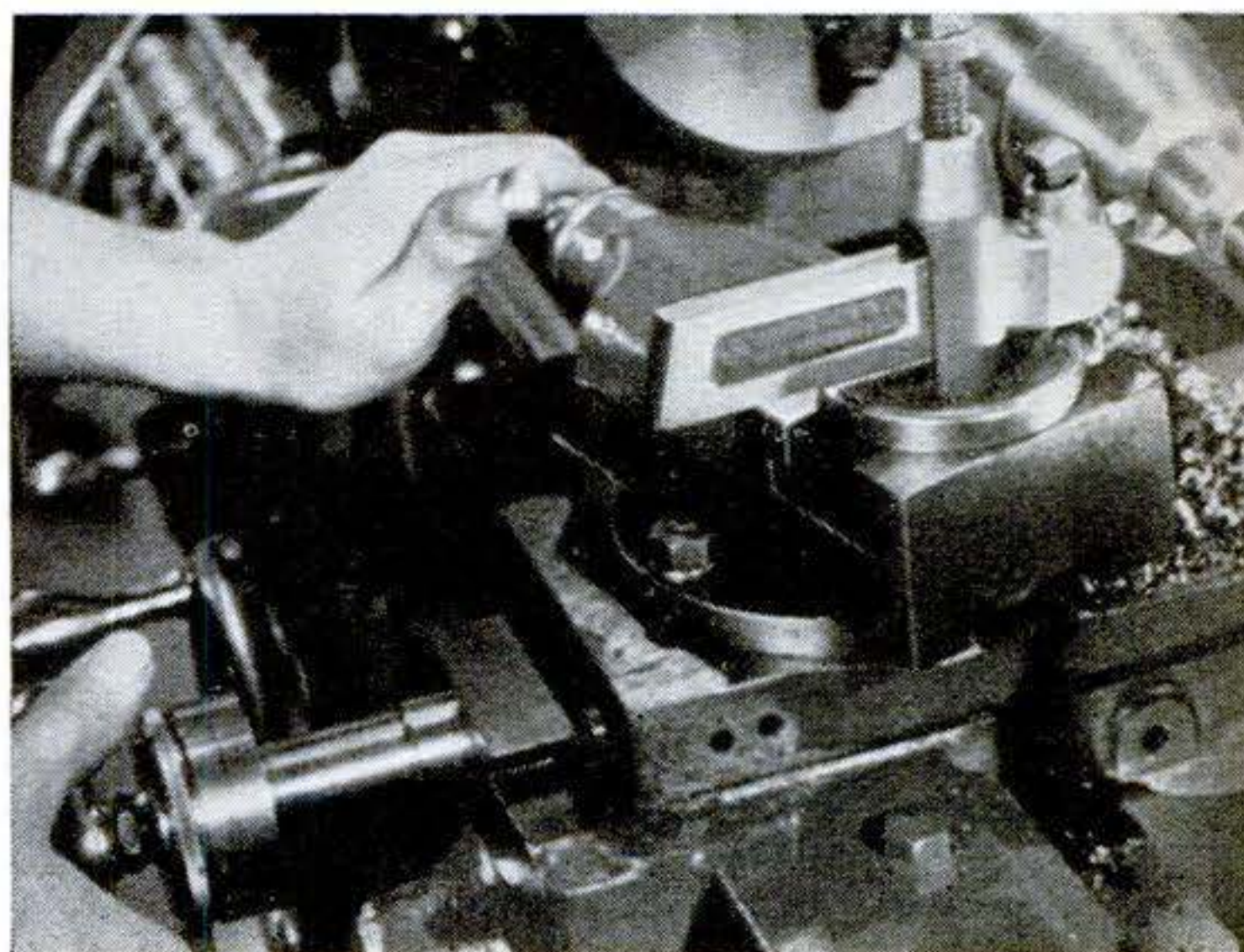
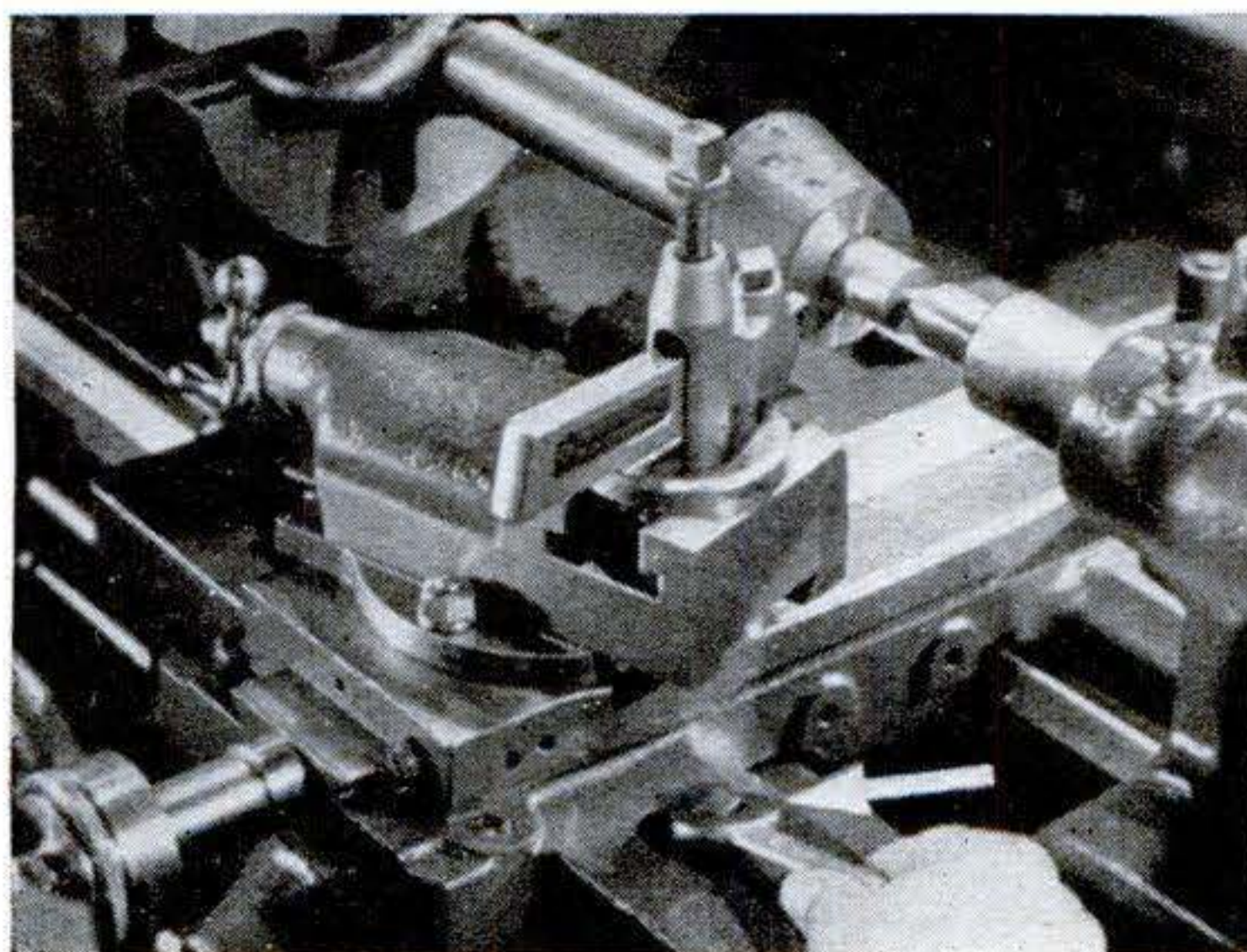
3 For the 20-deg. taper, the rest is first swung to 90 deg. on the scale, which brings its feed screw parallel to the work center line, then back the desired 20 deg., when it will be at the 70 mark

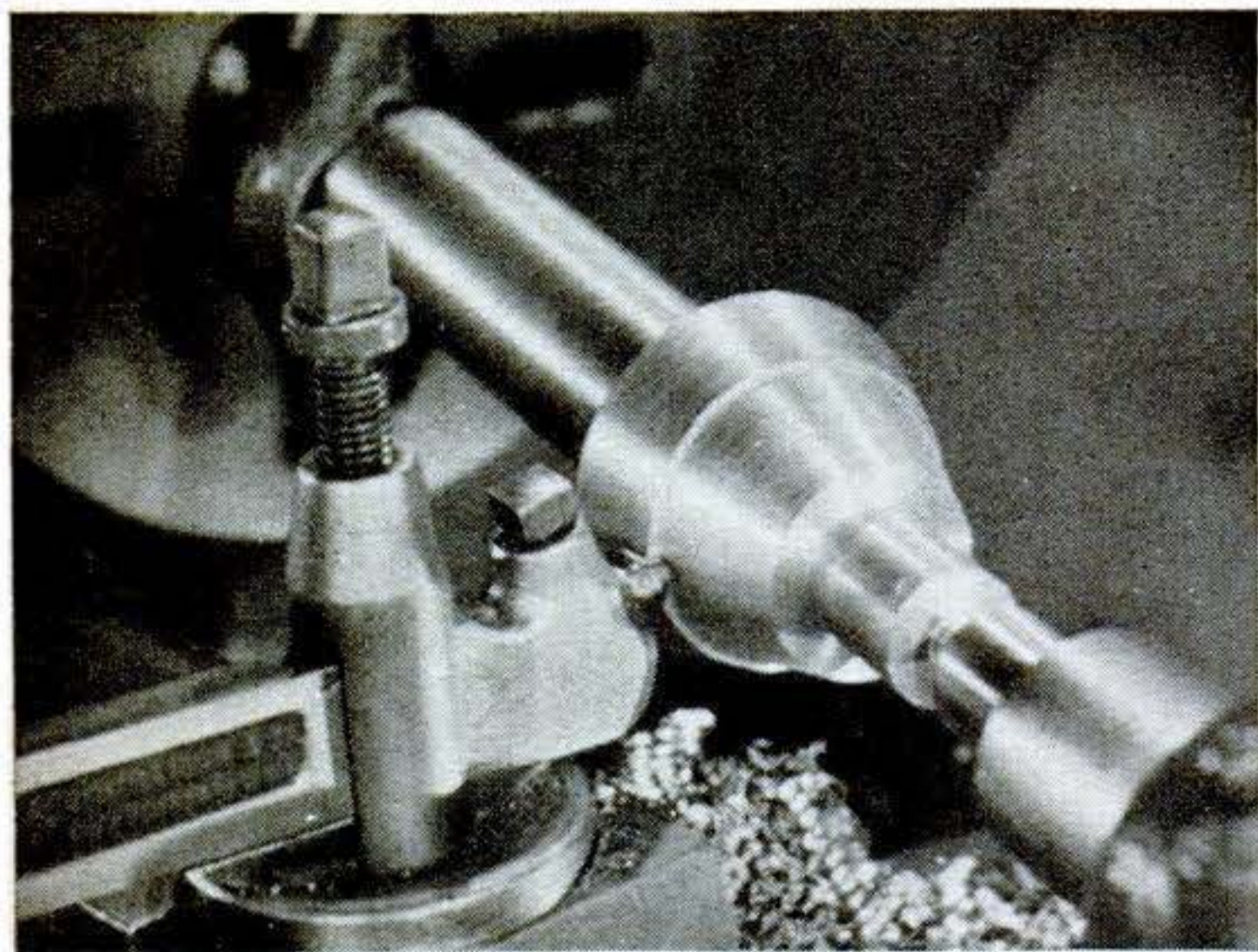
5 Were the carriage to move, tool travel would in part be parallel to the center line instead of at the desired angle, spoiling the taper. Therefore the carriage is locked as shown by the arrow below



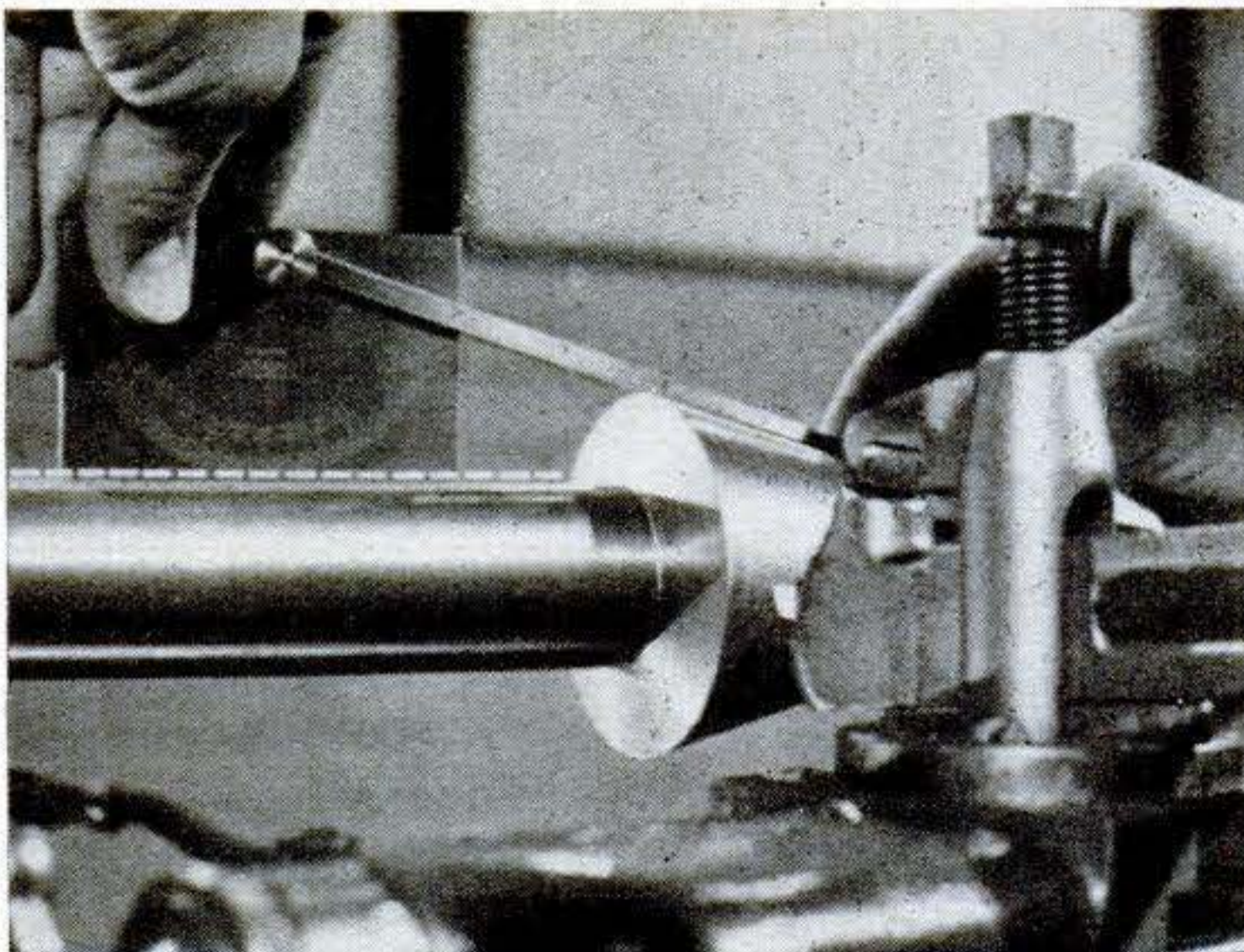
4 Two nuts are tightened to lock the rest at this angle. It will advance the tool on a line at 20 deg. to the center line of the work. This, already turned except for the tapers, is mounted on centers

6 With the cross feed (at bottom left) the tool is set to a depth of cut depending upon the speed, type of tool, and metal being turned. Too heavy a cut may swivel the rest slightly, causing inaccuracy

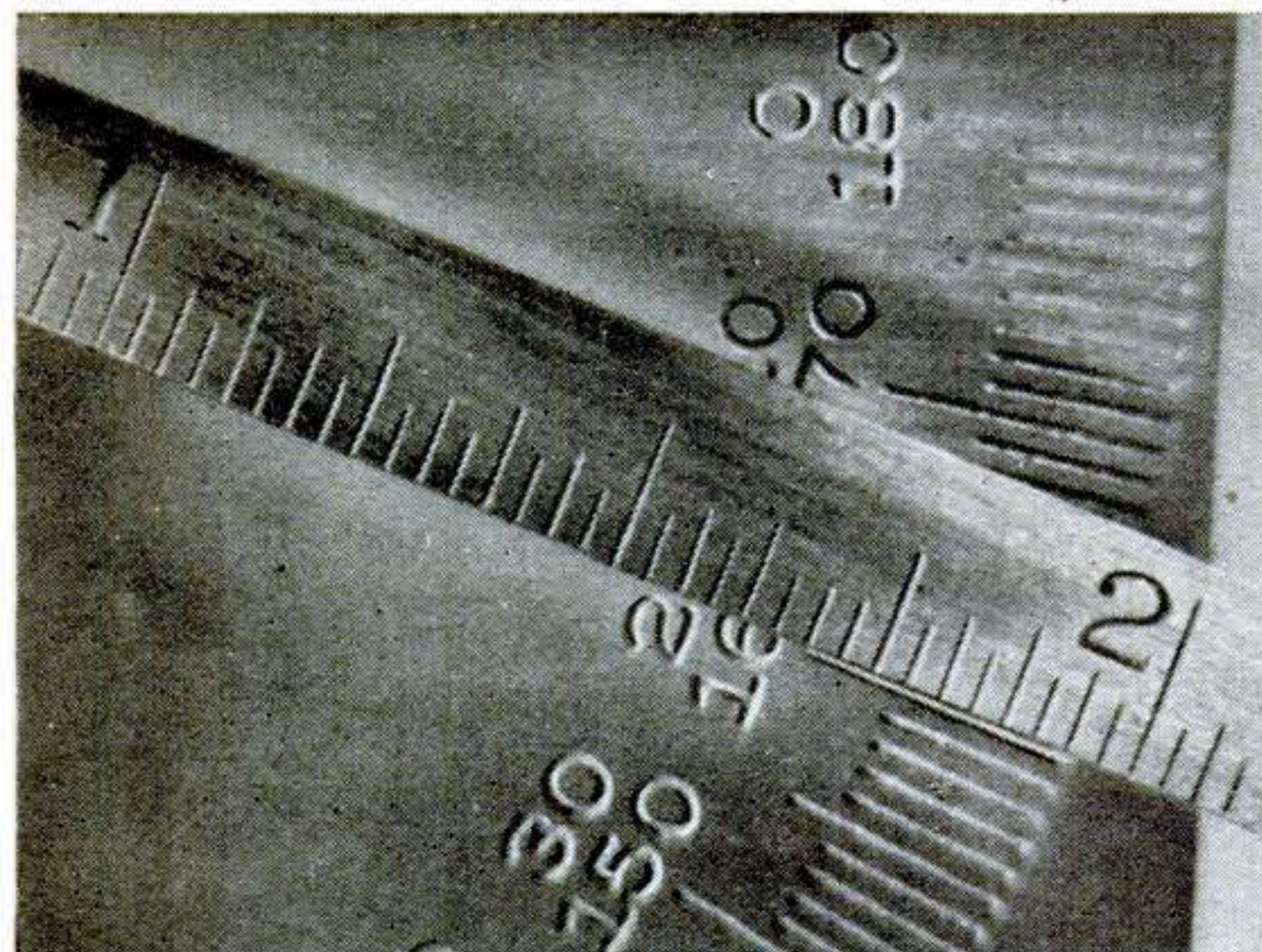




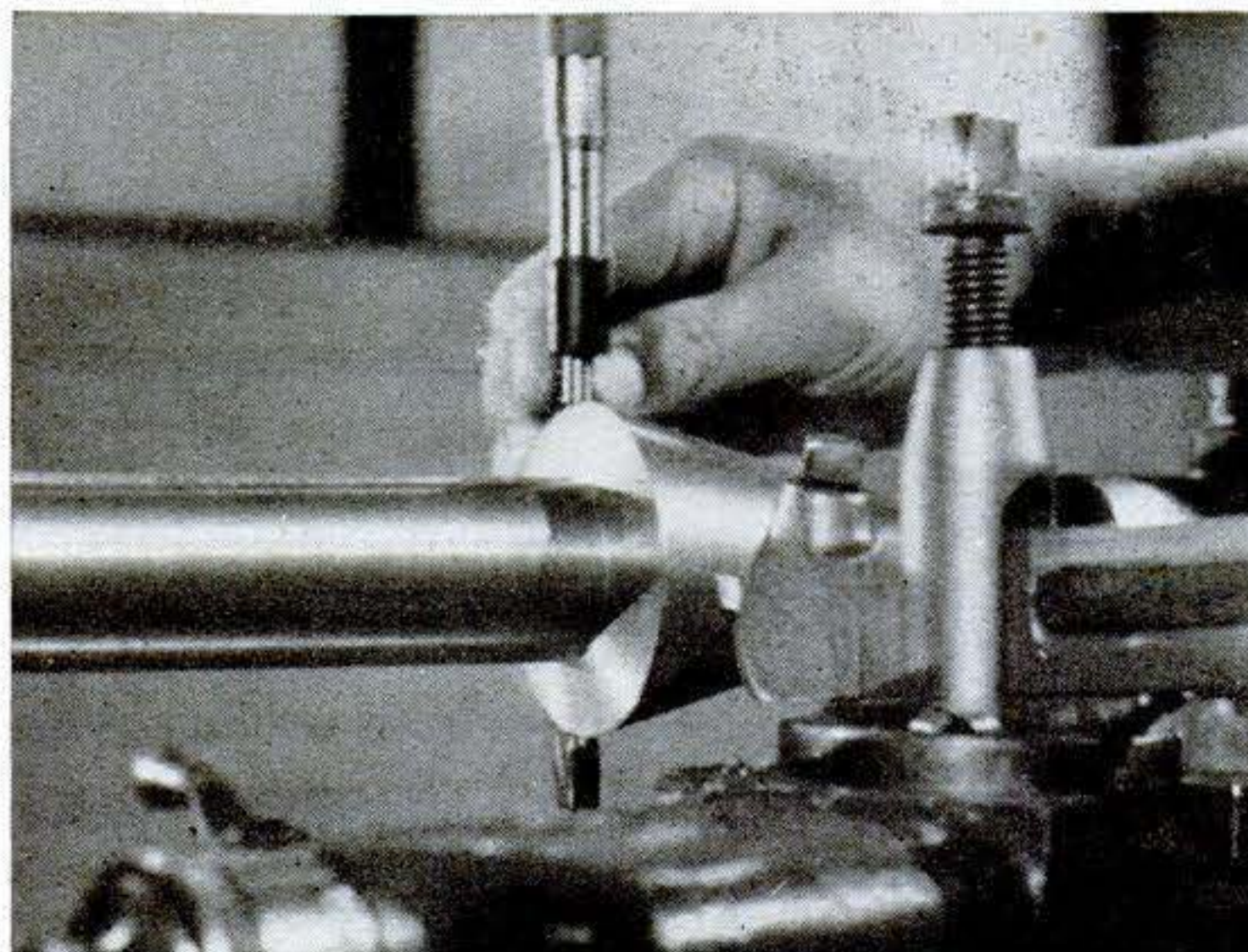
7 Only the compound-rest feed is used to traverse the tool from right to left across the work in cutting the taper. After each pass, the tool is advanced by the cross-slide feed screw for a new cut



8 After a trial cut, the taper must be checked. This can be done with a bevel protractor. The base of this instrument must be set on a machined surface, in this case the straight part of the work



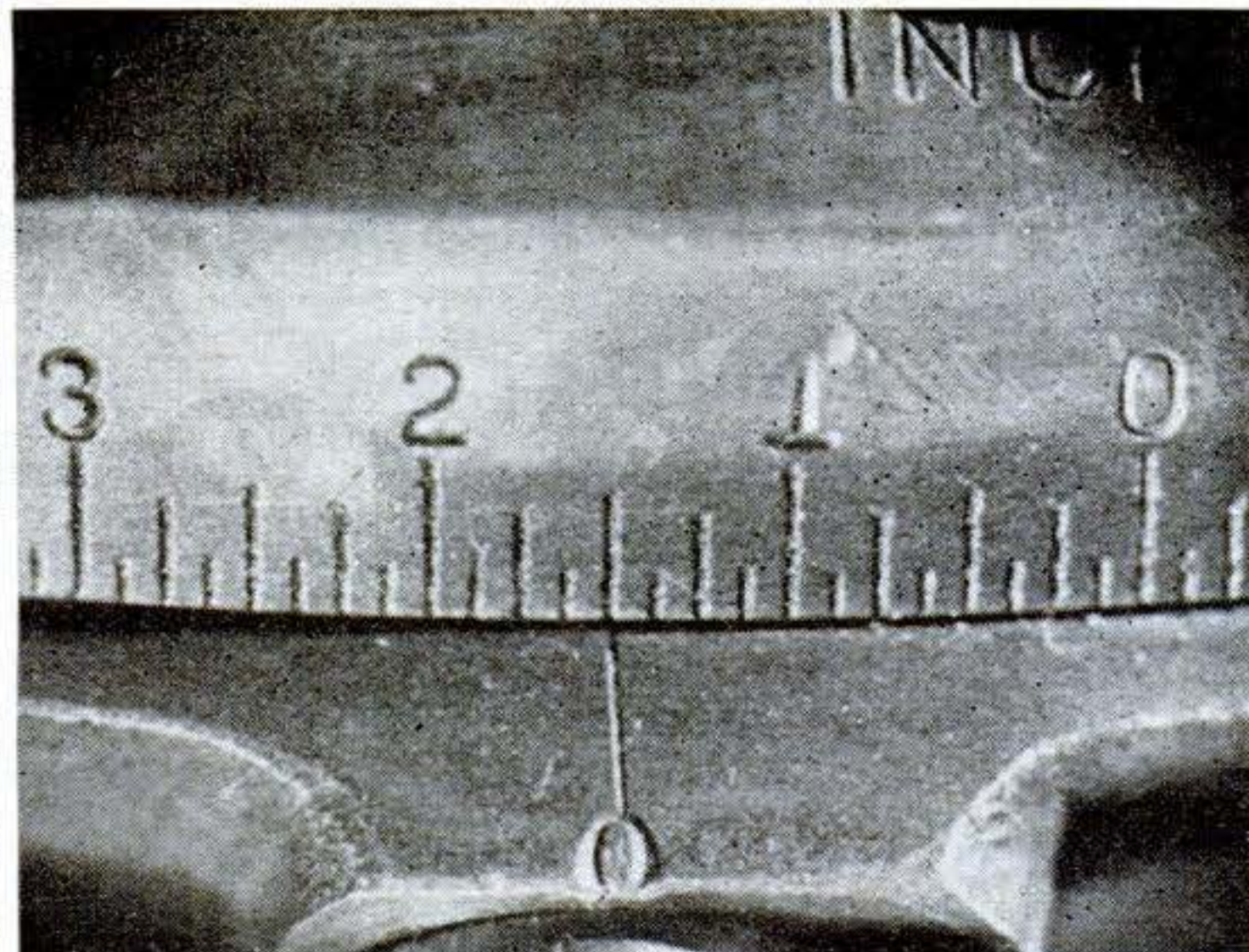
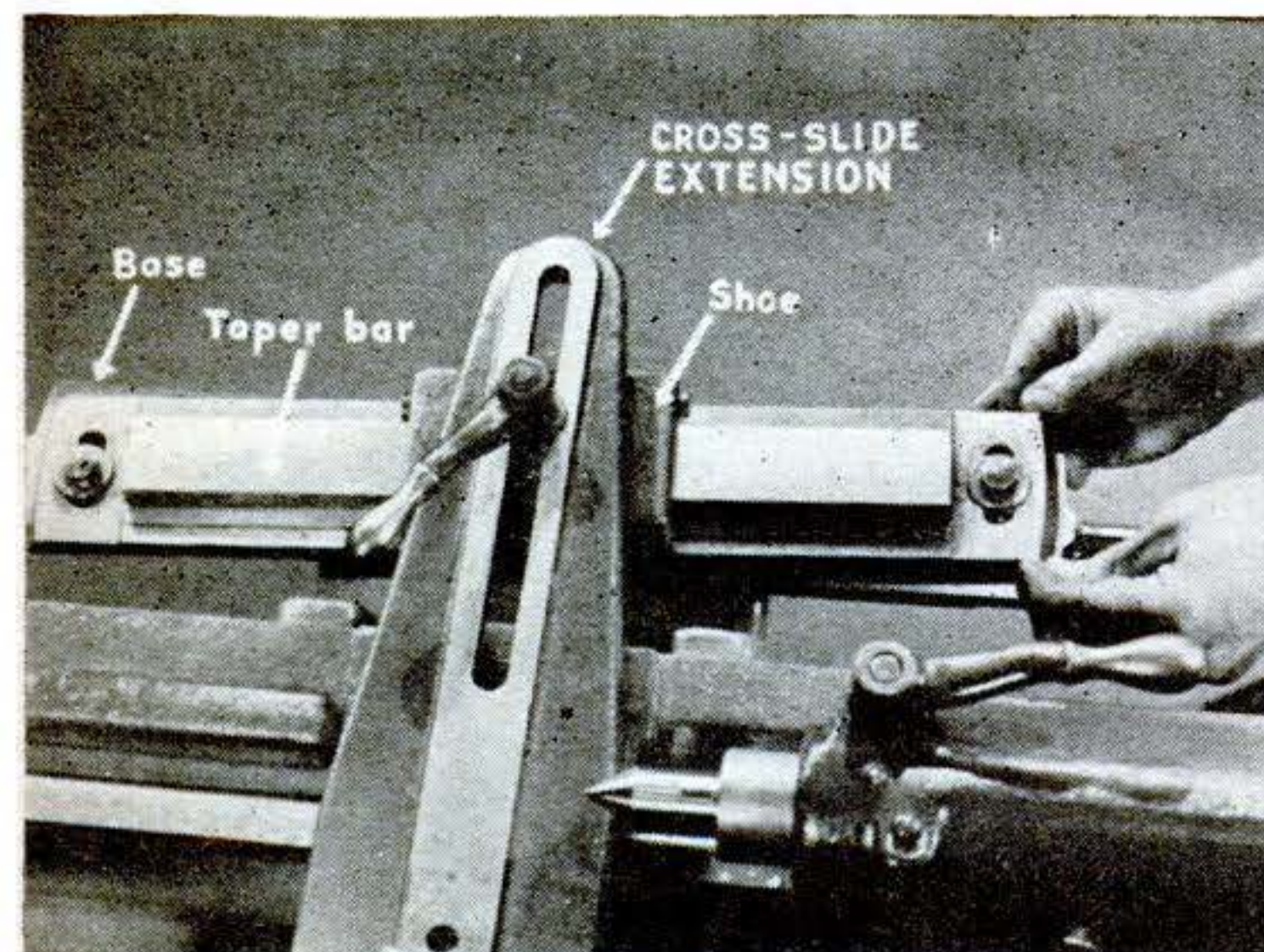
9 Since the protractor arm lies exactly on the 20-deg. mark, the setup is correct. Were it not, the rest would be reset for new trial cuts. A taper ring gauge would check both size and taper

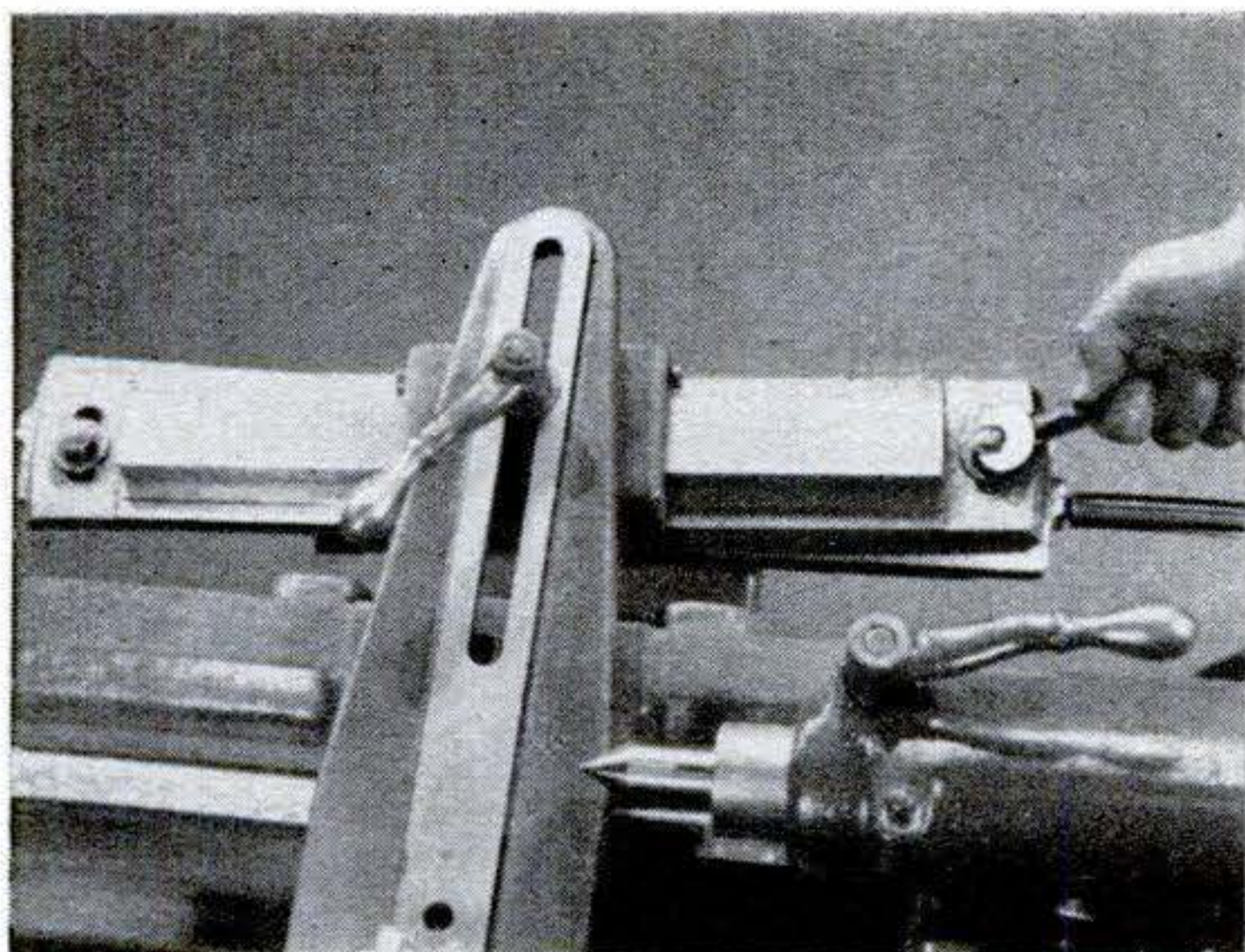


10 A micrometer may be used to measure the big end. Any oversize is noted and one or more cuts are made until the tool has been advanced far enough by the cross feed to remove the excess metal

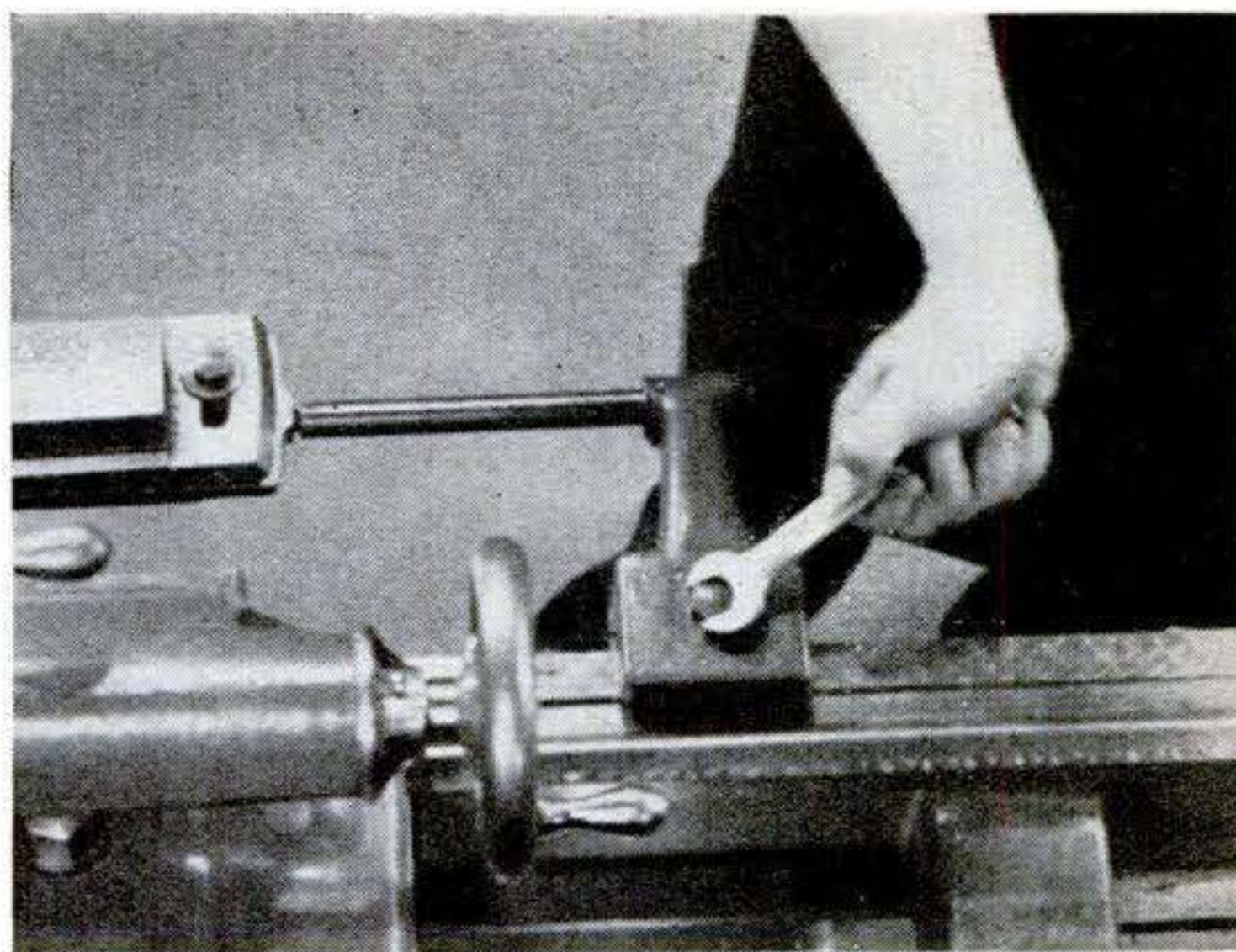
11 For slight tapers, long or short, the taper attachment is useful. It consists of a bar that can be locked at an angle to the bed and a sliding shoe which can be clamped to a slotted cross slide

12 At the right end, the taper bar is graduated in terms of inches of taper per foot. The job calls for a $1\frac{1}{2}$ " taper. Therefore the $1\frac{1}{2}$ mark on the bar is aligned with the index mark on the fixed base

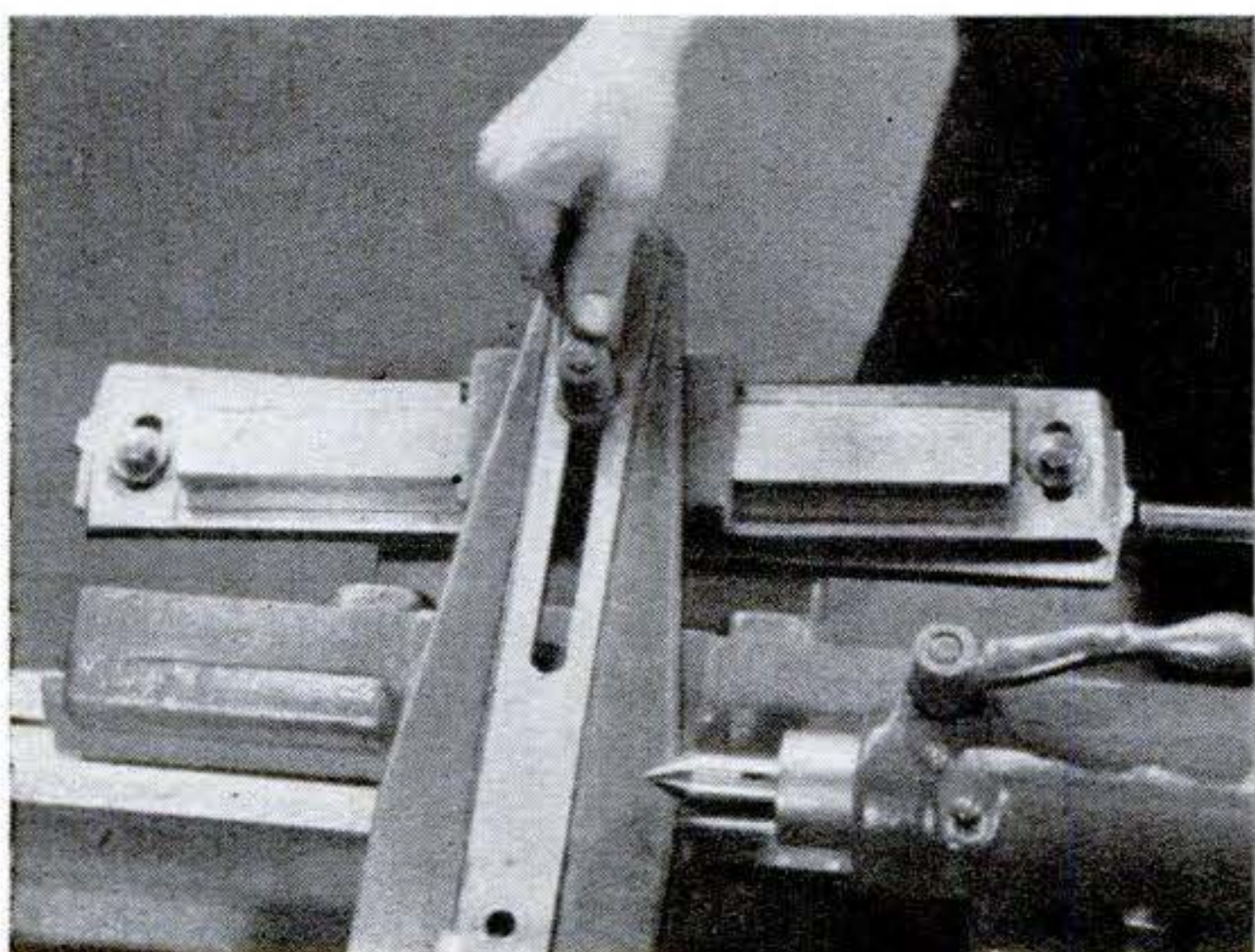




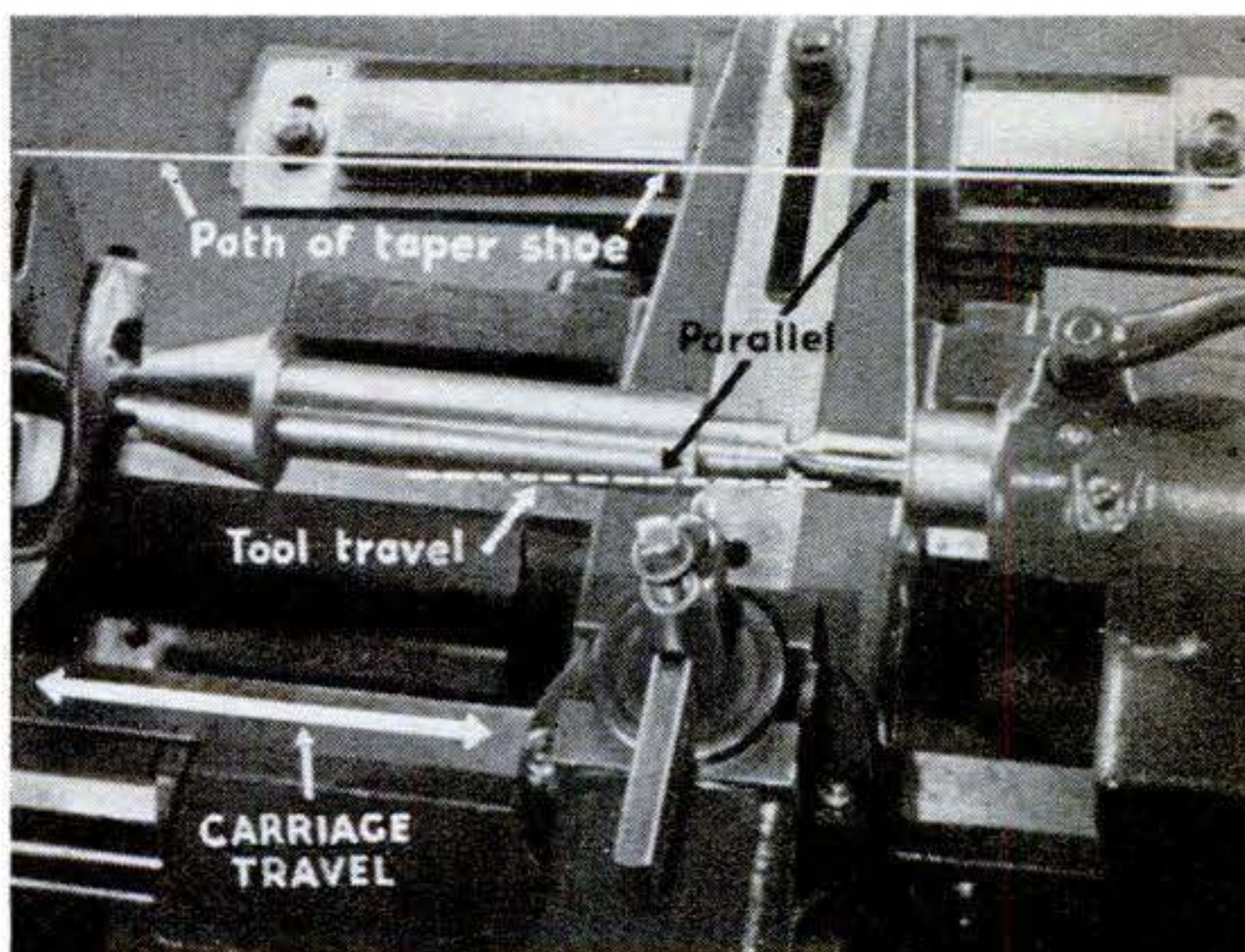
13 The bar swivels on a pivot set midway between the slots. When it has been adjusted to the desired setting, both clamping bolts are tightened, care being taken not to alter the setting meanwhile



14 If the taper attachment were to move during the turning operation, an inaccurate cut would be sure to result. It is therefore wise to tighten the bracket that clamps it to the lathe, as above



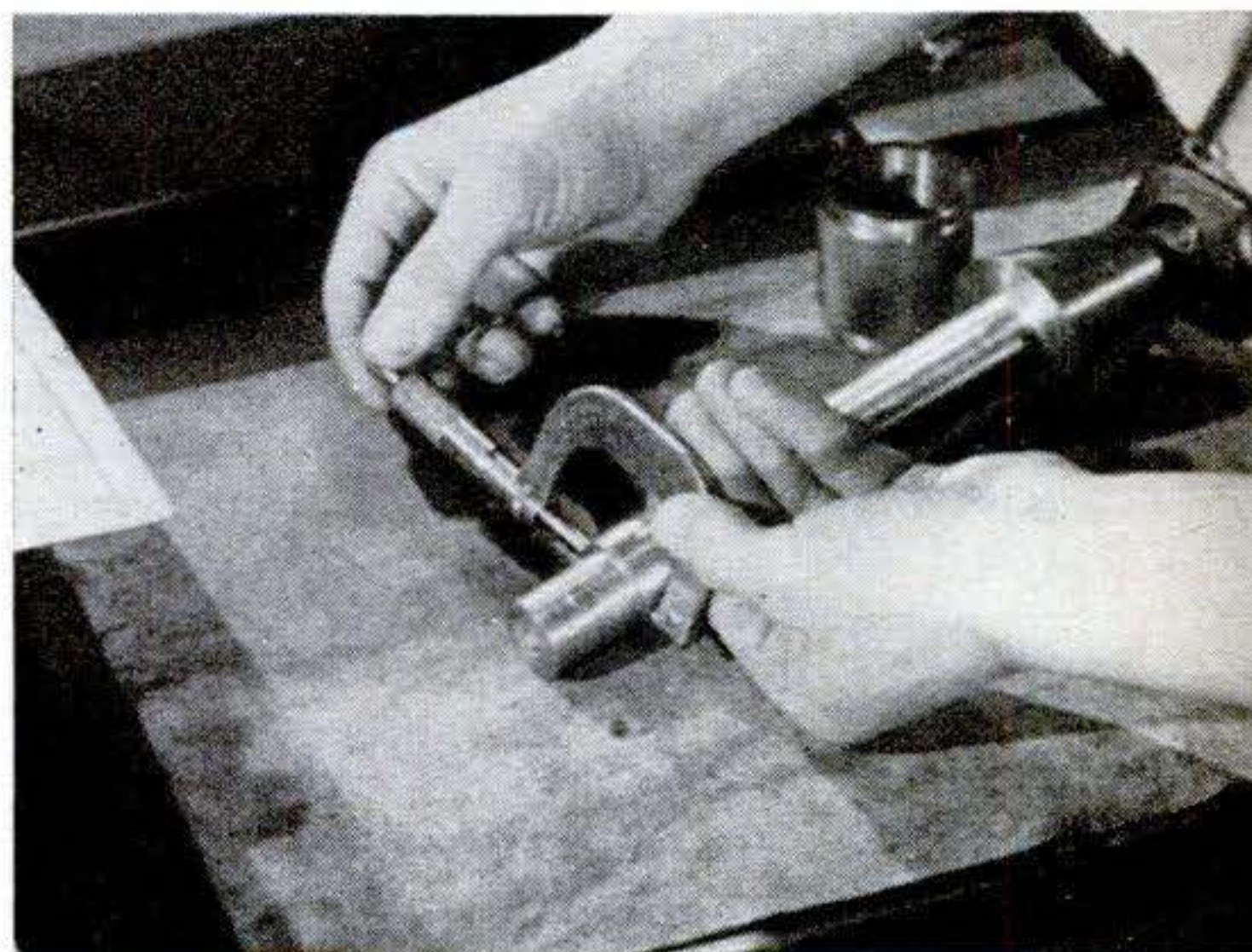
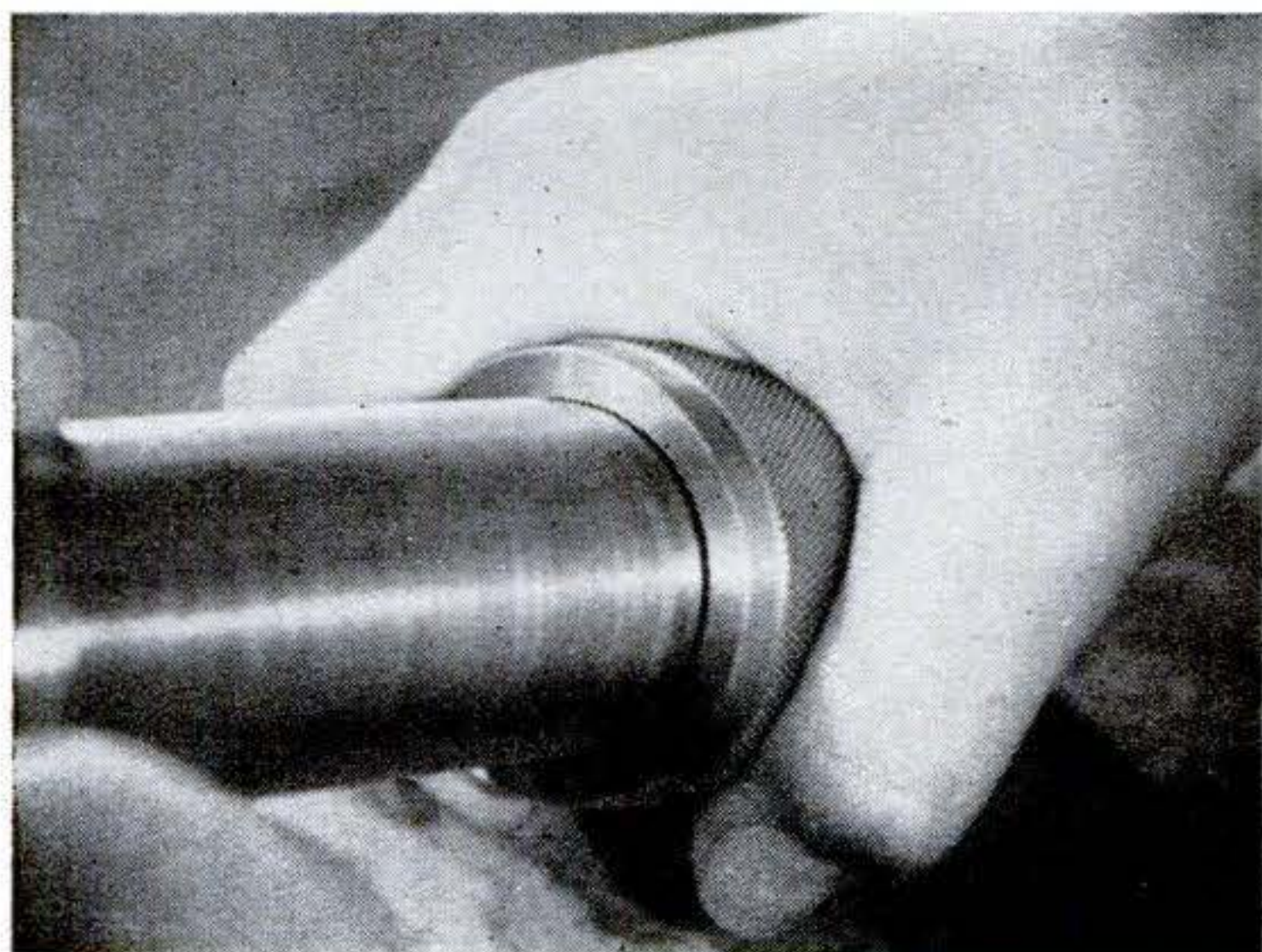
15 A clamp handle locks the sliding shoe to the slotted cross slide. The screw that usually secures the slide to the cross-feed nut has been removed, as may be seen at the bottom of this photo



16 Since the traverse of the cross slide is now governed by the sliding shoe, tool travel is parallel to the taper bar as the carriage moves. The tool is fed into the work by the compound screw

17 After a trial cut, the taper can be checked with a taper ring gauge. A gap between gauge and work shows that the taper is too small on the large end. The taper bar is readjusted accordingly

18 Since the large diameter of this taper is the same as that of the shaft, the small end is measured. If a micrometer is used, its contact surfaces are set back from the end half their diameter



NEW SHOP IDEAS

CUTTING HEAVY TUBING that weighed 150 lb. per foot was a problem that confronted F. J. Valentine, Inc., in an effort to make prompt delivery of sub-chaser parts to the Navy. Power-saw equipment was not obtainable, and job shops were too busy to take the work. So the Brooklyn manufacturer ransacked his plant for odd parts with which to improvise the unimposing but practical contrivance shown at the right. In addition to other miscellany, the device included an old drill press, and the whole setup served to support and rotate the tubing beneath a

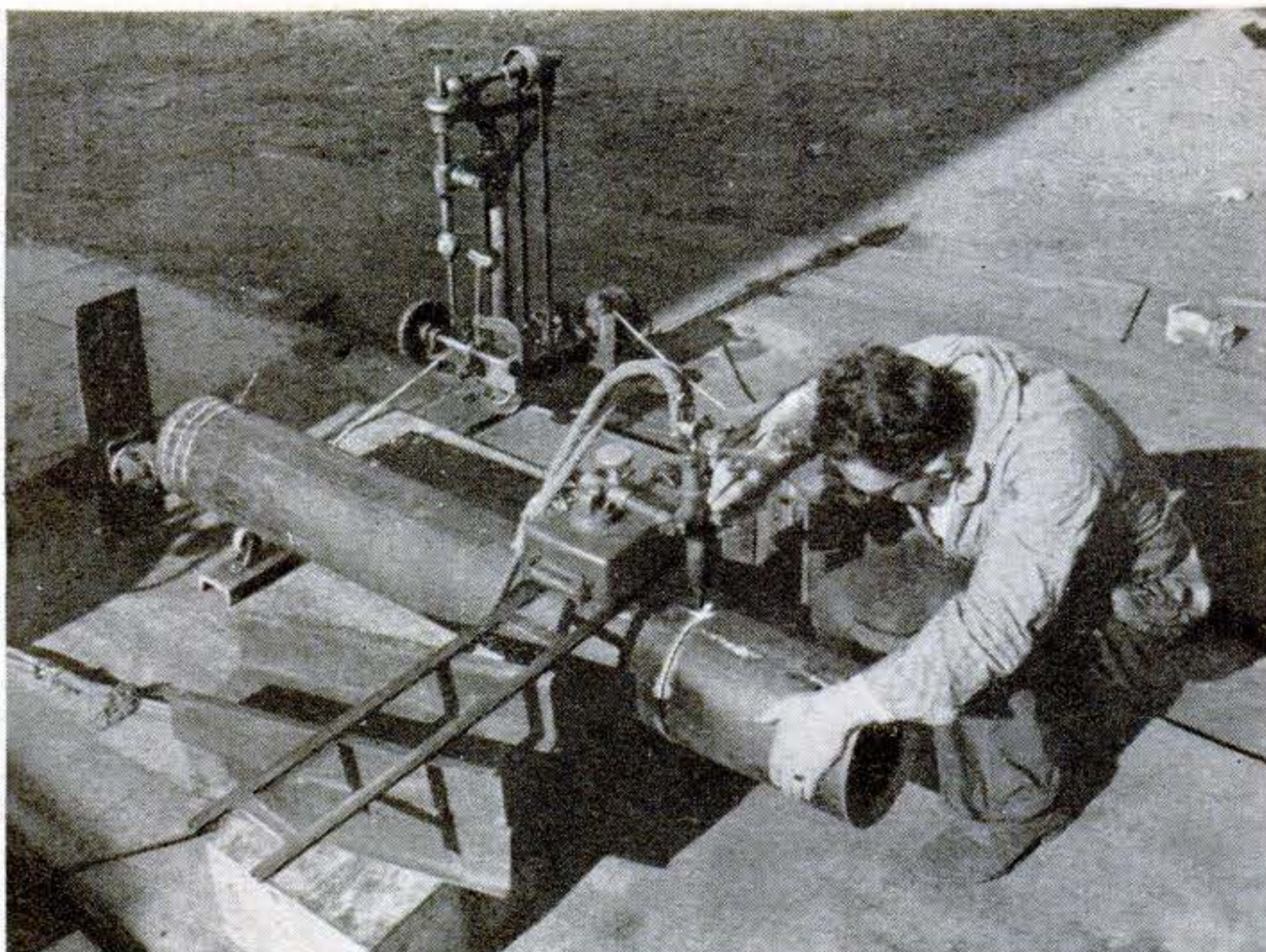
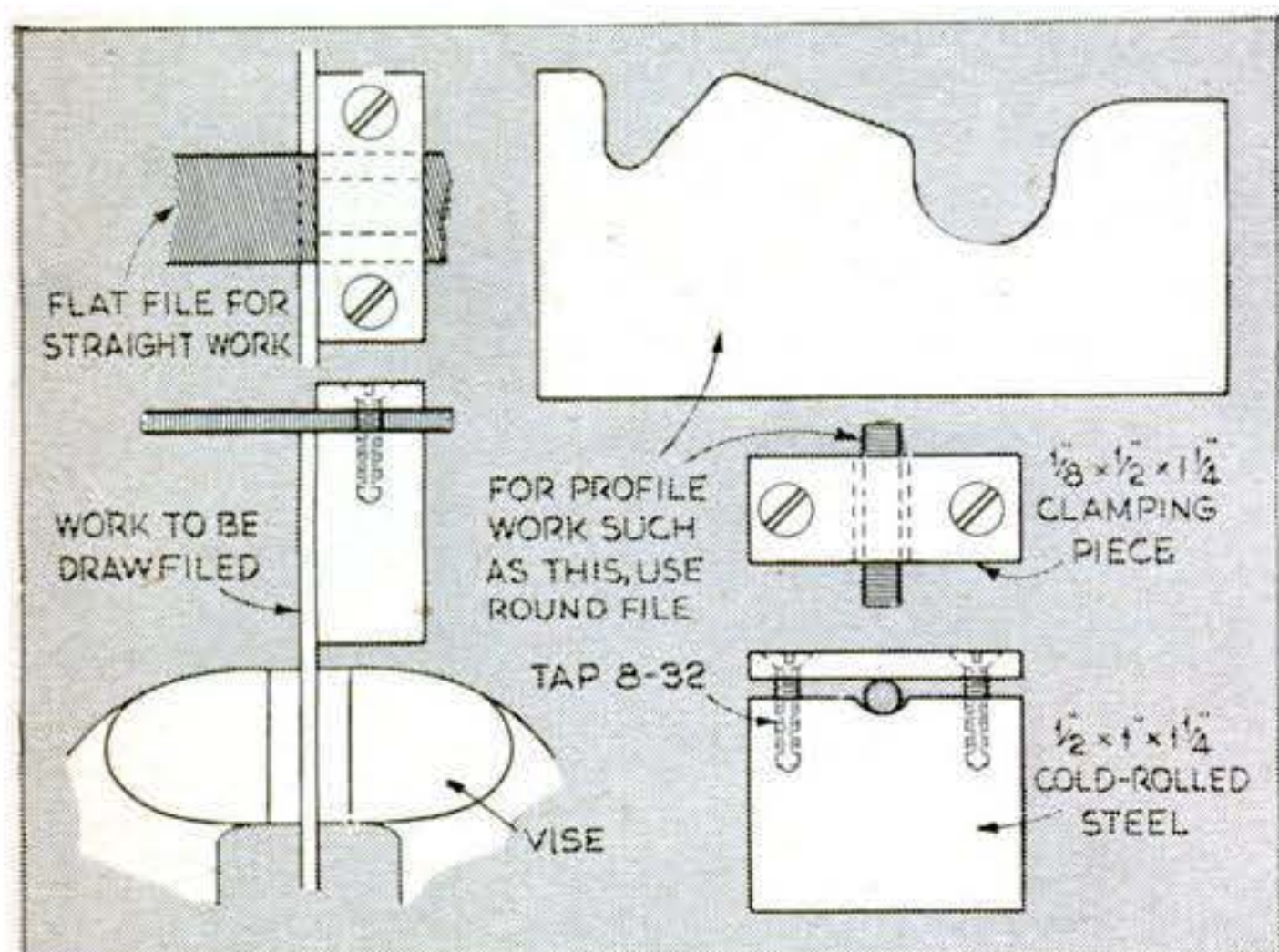


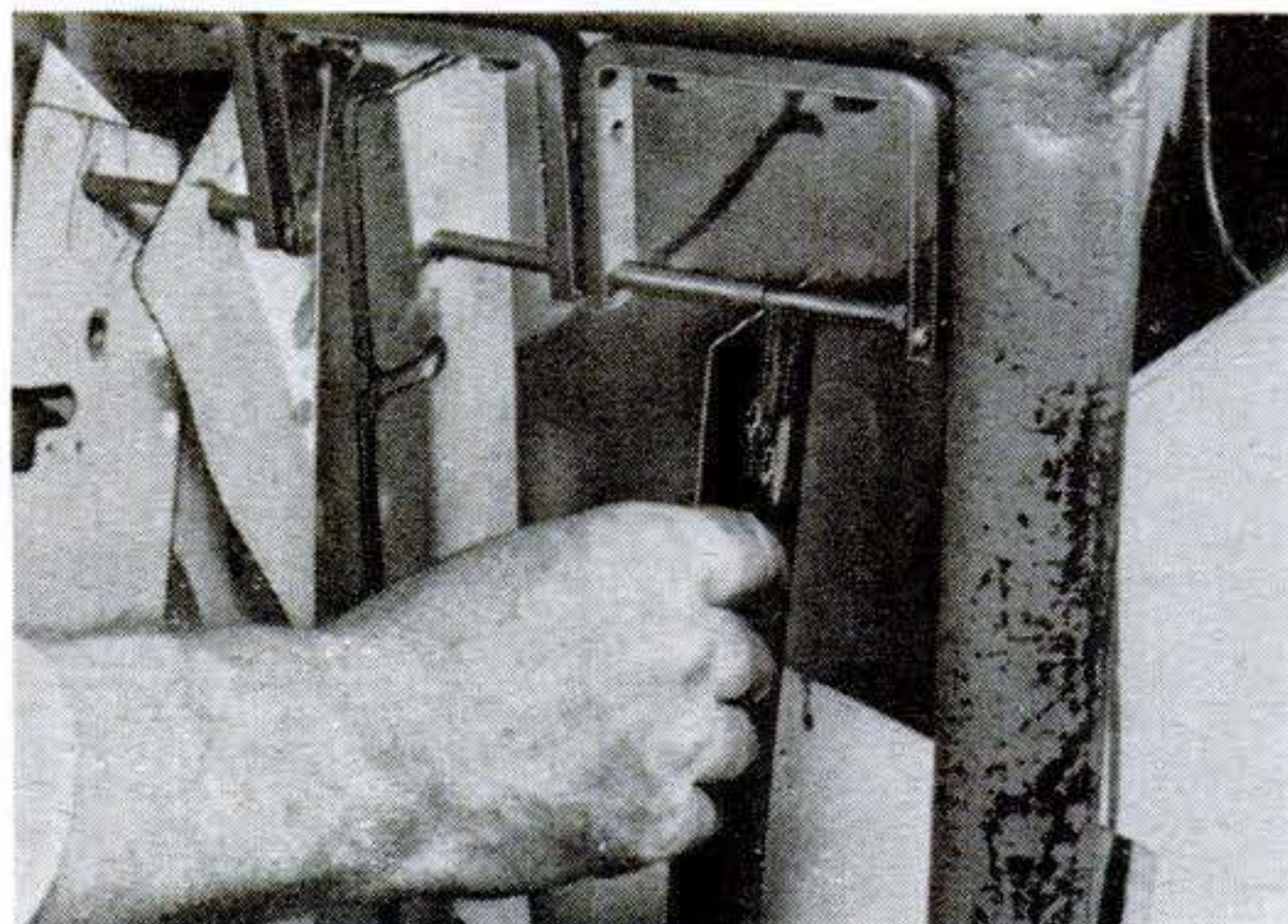
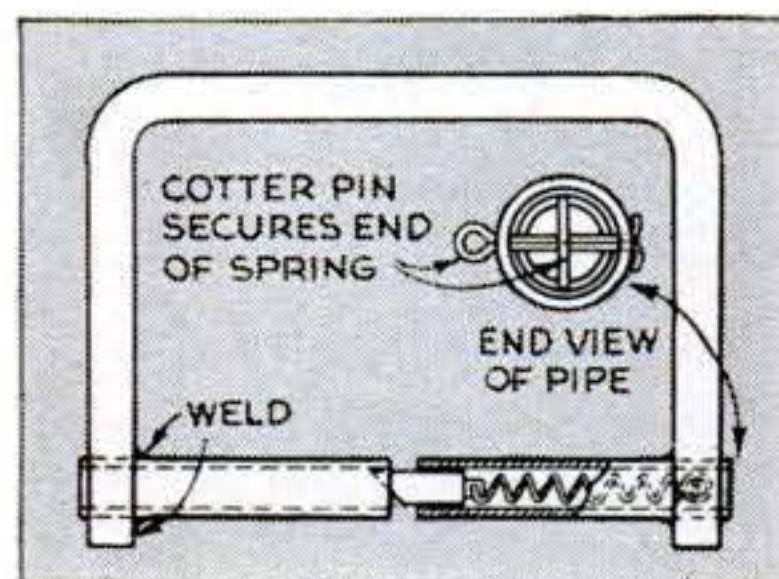
Photo courtesy Air Reduction Sales Co.

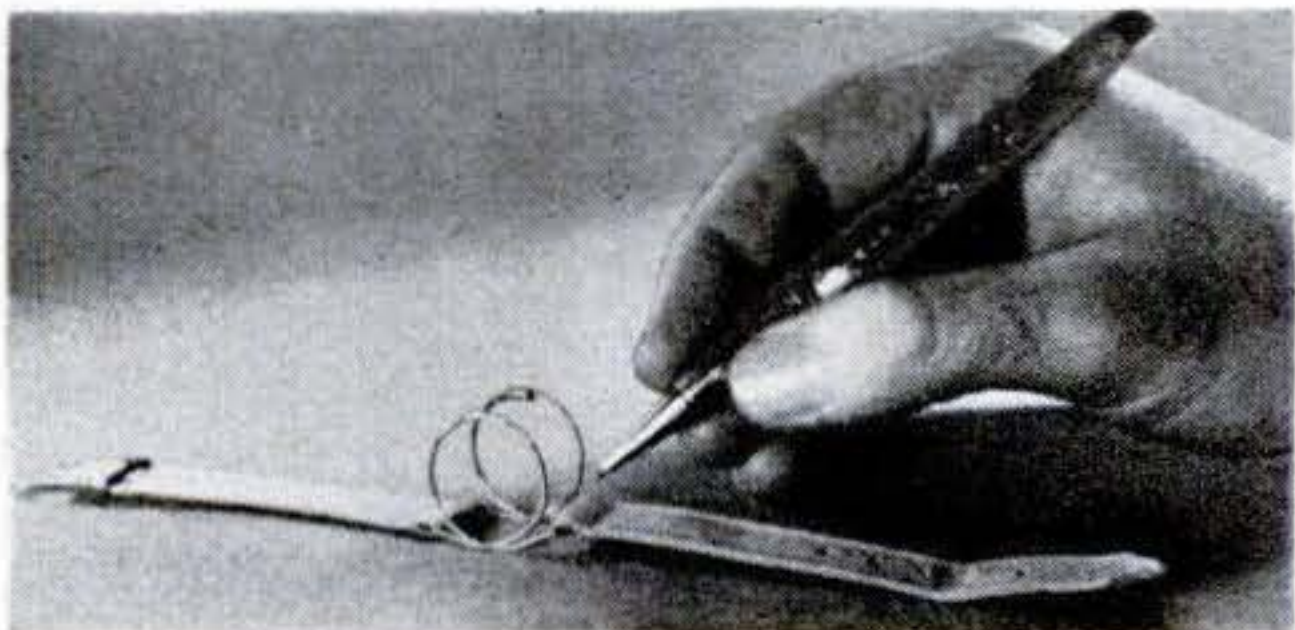
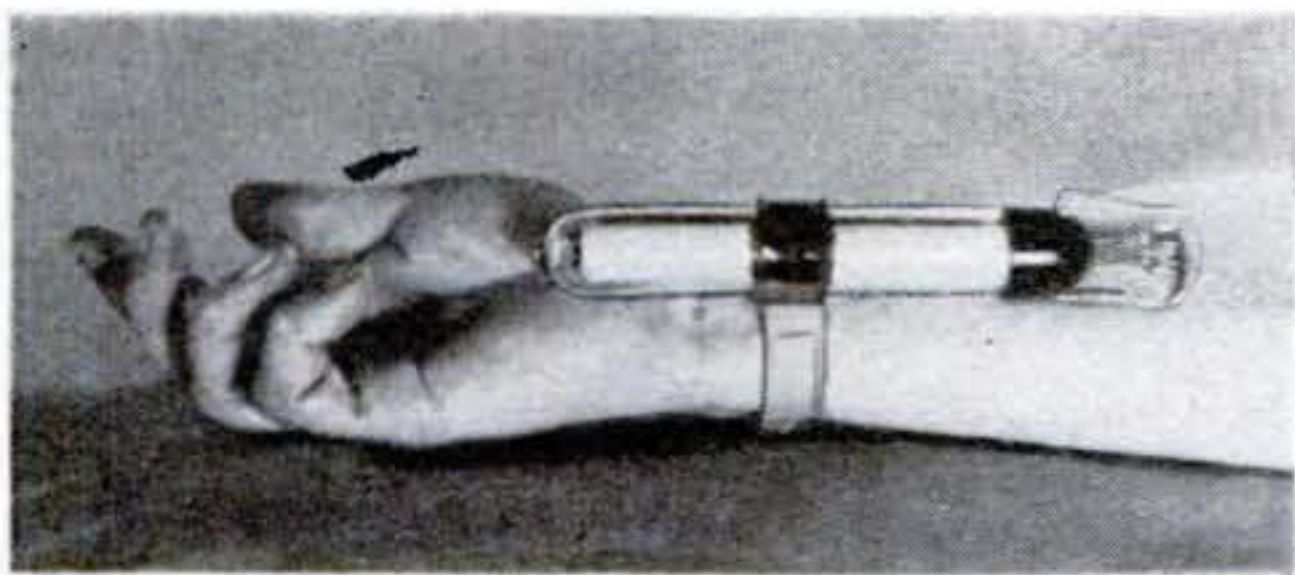
stationary cutting torch. The drill press, by means of a reduction gear, turned the tube at a speed of $\frac{1}{3}$ r.p.m. by reeling in a wire wrapped around it. End play was prevented by slanting the tube against an end roller.



DRAWFILING SQUARE EDGES of dies, gauges, and templates is made easy by the handy little tool illustrated above, which utilizes a flat or a curved file depending upon whether the profile of the workpiece is straight or curved. The device consists simply of a base of cold-rolled steel, $\frac{1}{2}$ " by 1" by $1\frac{1}{4}$ ", and a clamping piece of the same material, $\frac{1}{8}$ " by $\frac{1}{2}$ " by $1\frac{1}{4}$ ". Two screws attach the clamp to the base, as shown in the drawing. A half-round groove shaped in the head of the base accommodates a round file when a curved edge requires one. When clamped securely, a file is bound to cut a profile squarely if the base of the device is held firmly against the work. The tool can be used to make both male and female gauges. It will enable an operator to split a line and work off high spots easily.—H. D. CHAPMAN.

TEMPLATES BY THE DOZEN can be classified and racked in ready accessibility by hanging them on bars arranged in a holder as shown below. The holder may be of any size, but the bars consist of $\frac{1}{4}$ " tubing welded between the legs of a succession of steel U's bolted upside down to a frame of strong piping. Within these U's the tubing is divided by a gap of $\frac{3}{16}$ " bridged by an interior spring bolt beveled on the lower side like that of a door lock. Templates will not slide downward past this bolt, but the bolt will retract if they are lifted a bit, and then they can be pulled out sideways. The device was invented by Ben Kruce, of North American Aviation, Inc.

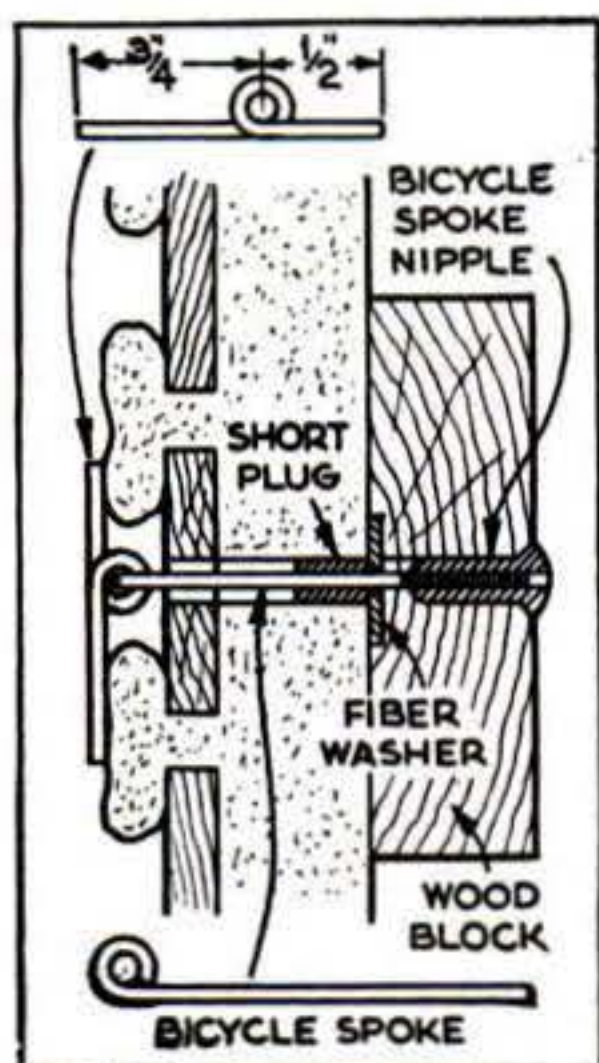




CONVERTING A FLASHLIGHT into a wrist light that will leave both hands free for a job can be accomplished with an inexpensive watch strap and two paper clips. Straighten the clips, slip one through each loop of the strap, and center them; then bend them, as shown above, into circles of a size to fit the flashlight snugly, and solder the ends together neatly.—R. S.

SHELLACKING CARDBOARD BOXES which contained nail sets, bits, sharpening stones, or similar small tools will strengthen the cartons sufficiently for permanent shop use. A first coat of shellac should be diluted with alcohol, but the second should be applied full strength. Household boxes can be treated in the same manner.—K. BIER.

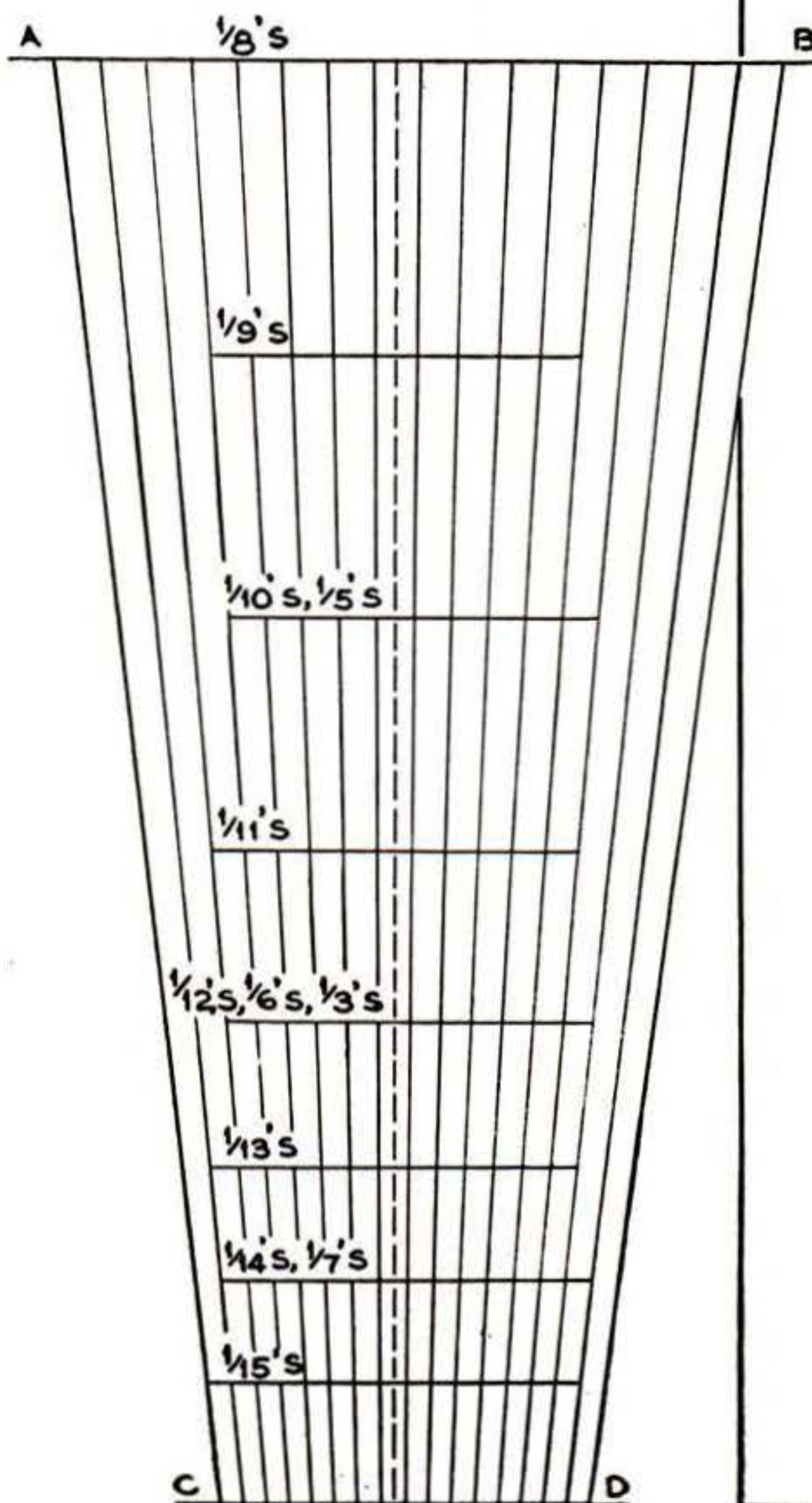
TOGGLE BOLTS of practically any length can be fashioned from two pieces of wire joined as in the drawing, according to an article in the British magazine *Mechanics*. How such a bolt



may be used to hold a block on a plaster wall is shown at the left. The hole in the wall must be big enough for the loop of the toggle to pass through. A bicycle spoke makes a good bolt, being already threaded to take a spoke nipple, but any wire that has a thread can be used for the bolt. Wings looped long on one side will drop into a vertical position.

A DRAFTSMAN'S RULE divided into fractions other than the more common ones is reproduced full size at the right, and the method by which it was divided is shown below. Draw the parallel lines *A-B* and *C-D* 4" apart. Mark off 1" in sixteenths on *C-D*, erect a perpendicular center, mark off 1" into eighths on each side of center on *A-B*, connect corresponding points with straight lines, and add a dotted line halving the first division left of center.

Even fractions are obtained by holding a ruler at right angles to the center line and moving it up and down until a 1" interval is divided into the desired number of units. Odd fractions can be obtained by using the dotted line as a perpendicular. Celluloid engraved with a penknife and a little India ink makes a lasting rule.—FRANK SHORE.



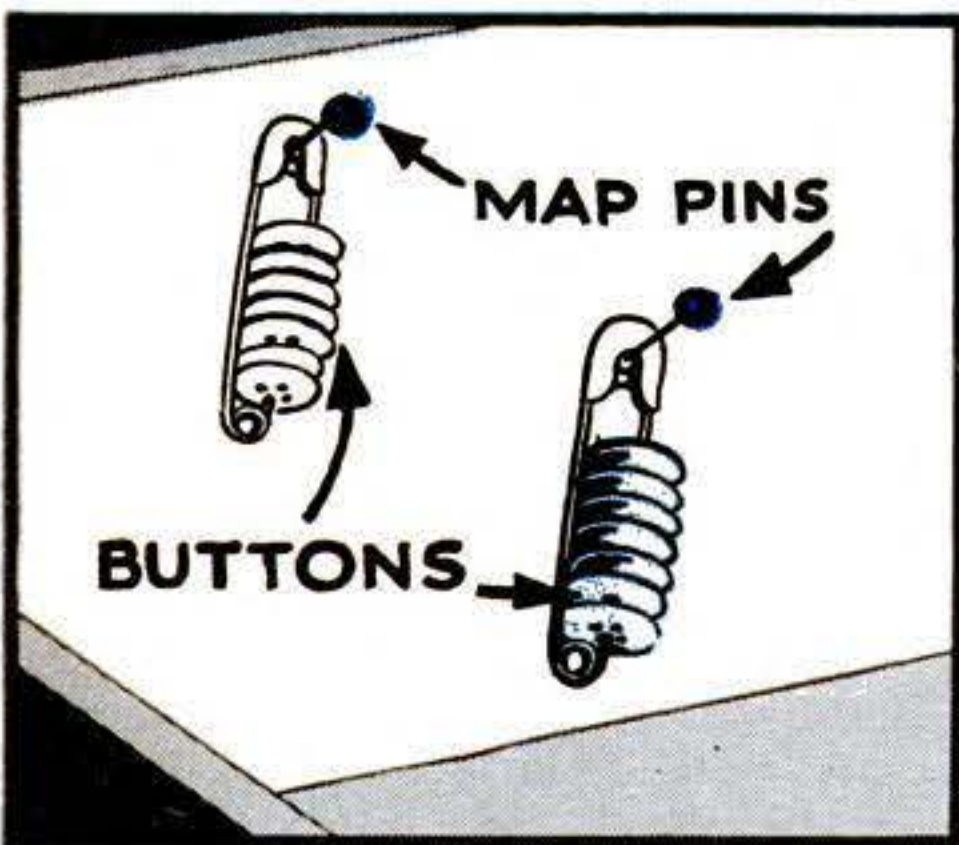
KEEPING THE HOME



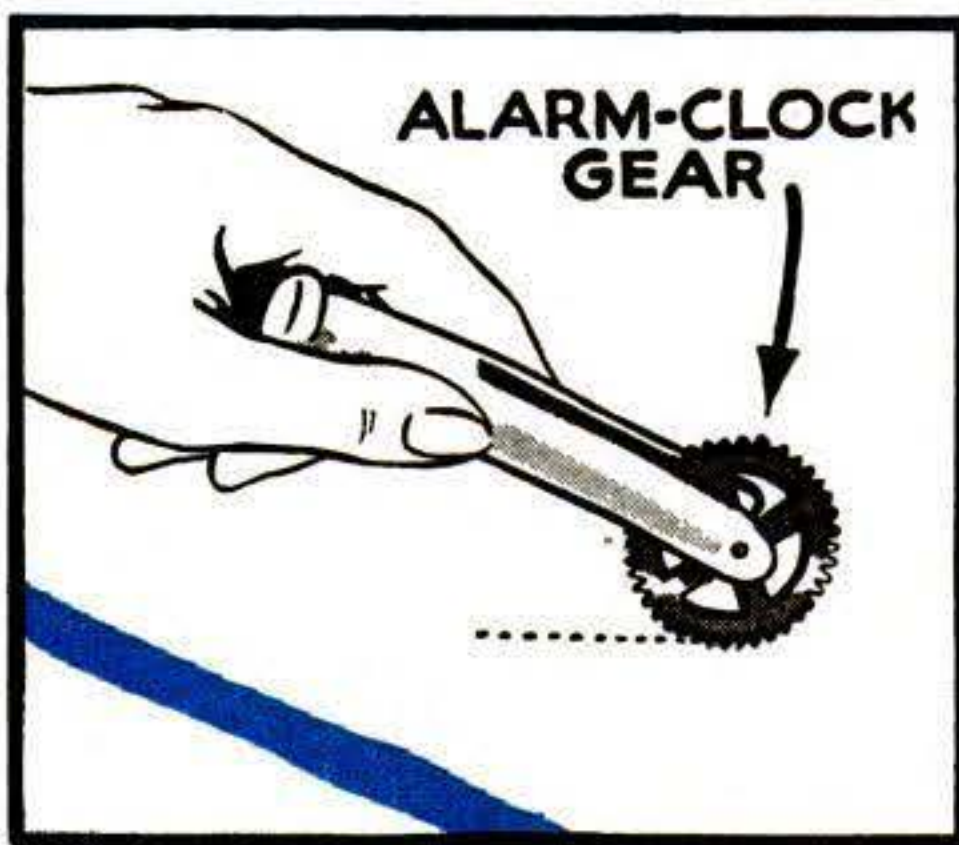
Ball fringes will stay soft and fluffy after the rest of a curtain has been starched if the balls are gathered together and tightly encased in an oiled-silk bowl cover before the curtain is put in the starch. Tie the cover snugly with string



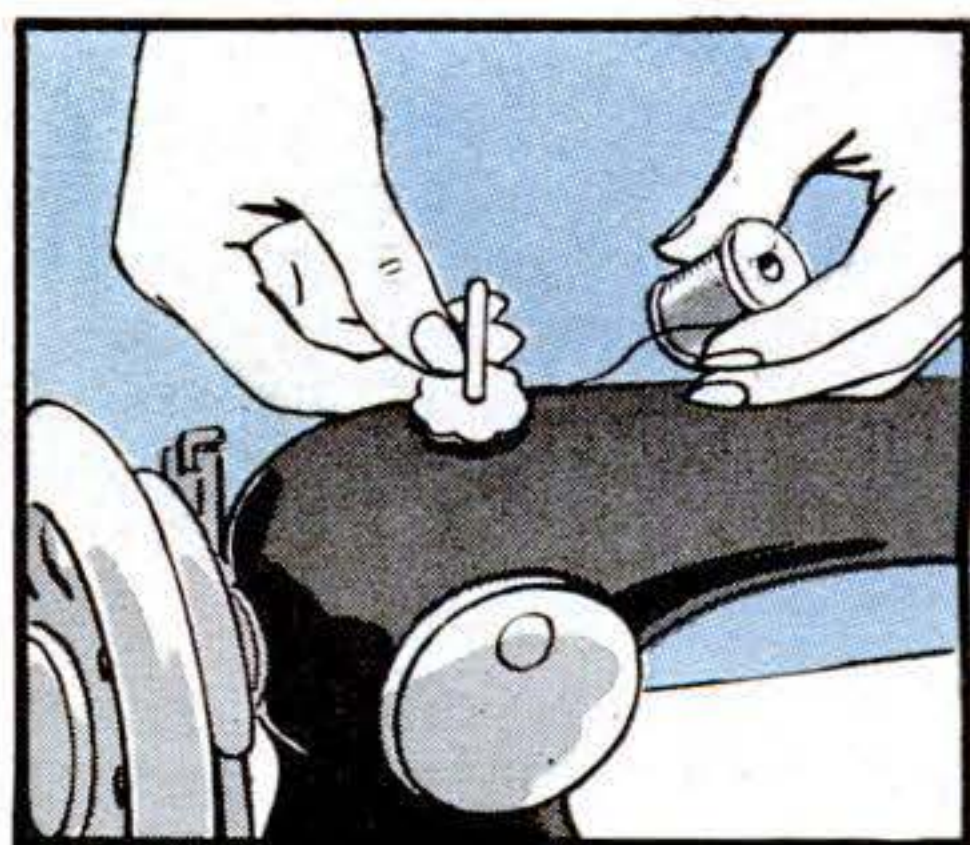
A wad of chewing gum will quickly lose its grip on woolen clothing or other such fabric if it is thoroughly chilled with a piece of ice. The ice will work just as well if it is wrapped in oiled silk to prevent water stains on delicate goods



You won't have to look far for matching buttons if you string those of a kind on safety pins as the buttons slowly accumulate. Suspend the strings on map pins

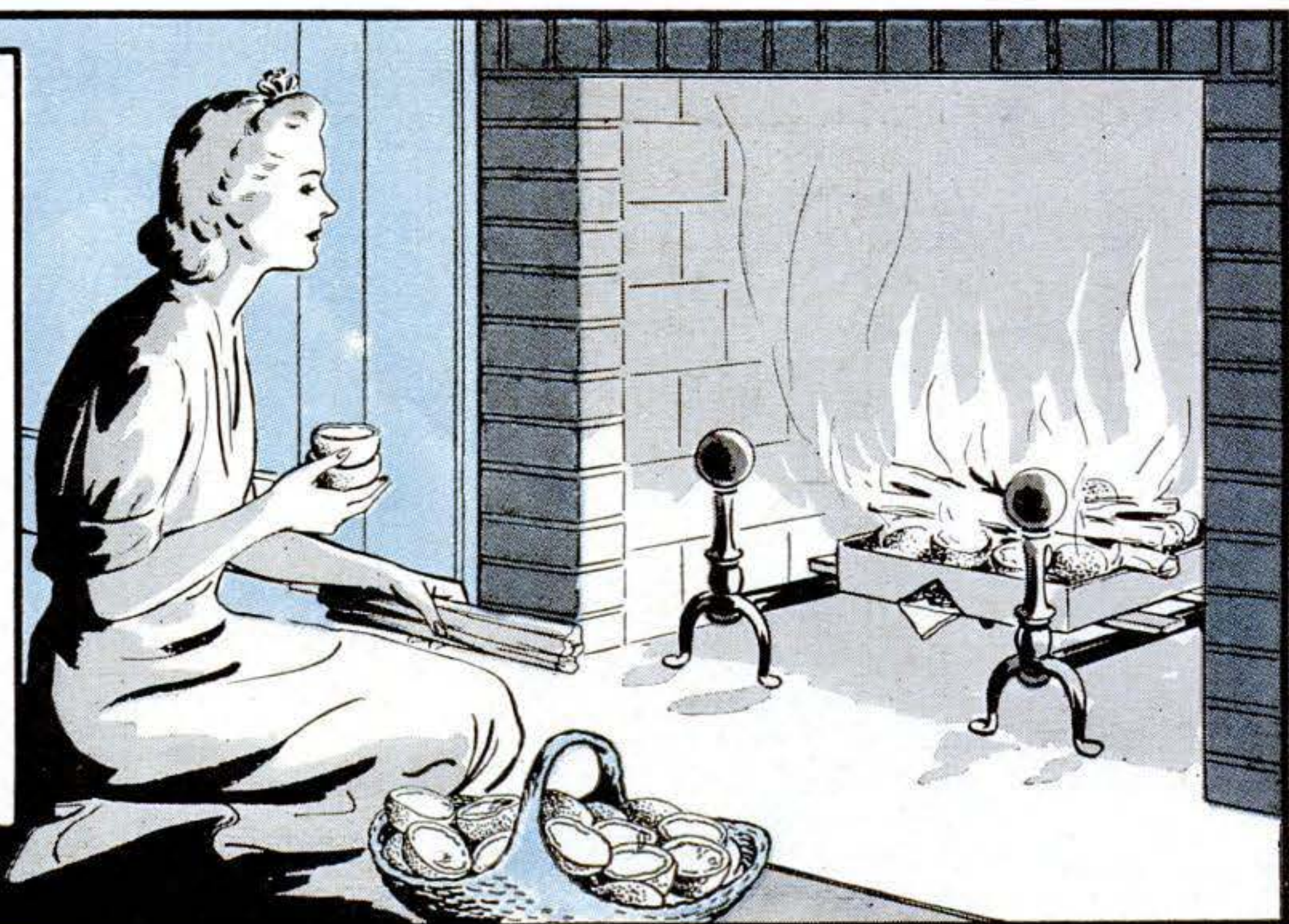


Held in the fork of a clothespin with a coter pin as an axle, an old alarm-clock gear will make a handy tracing wheel, excellent for copying patterns and the like

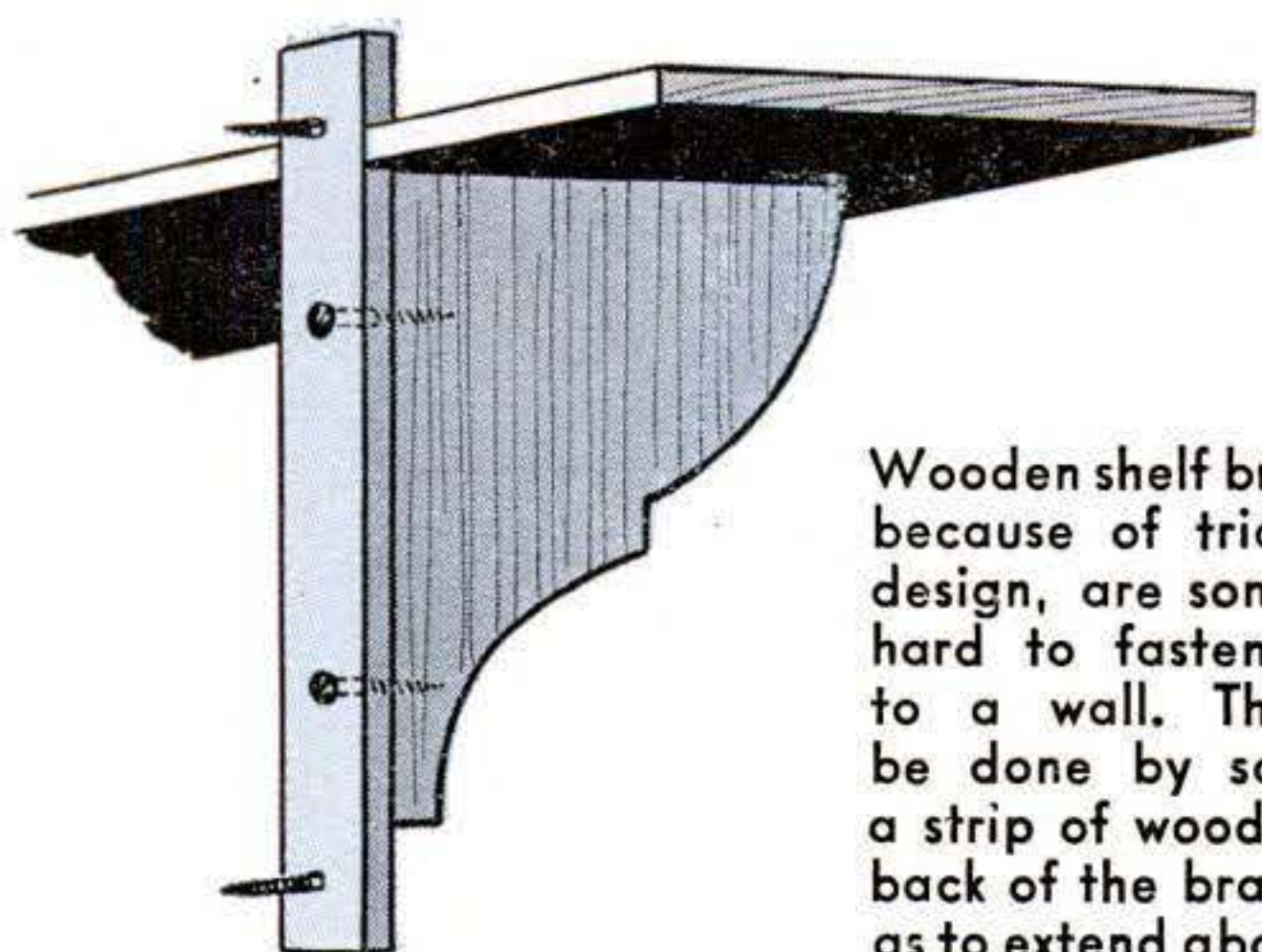


Silk thread will not tend to unwind too fast on your sewing machine if the motion of the spool is retarded with a bit of felt slipped over the spindle

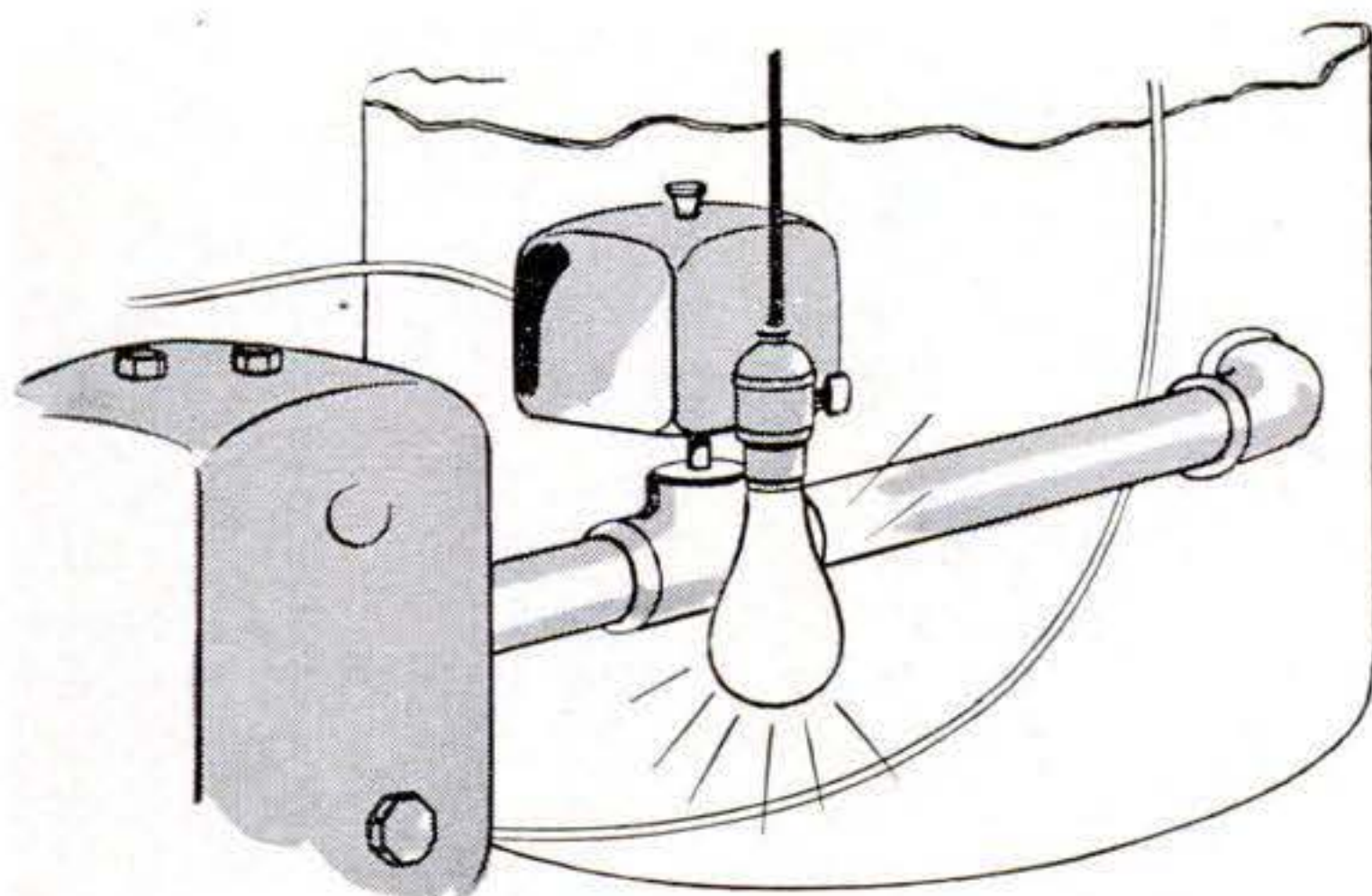
If you would add a touch of novelty to the hearth in your living room, save up a generous supply of orange peels and dry them well. Because of their oil content, dried orange peels kindle quickly and burn with a pleasant aroma. If you lack a grate, fashion one out of a shallow box held up by andirons. Holes in the box near the bottom help the fire to catch quickly



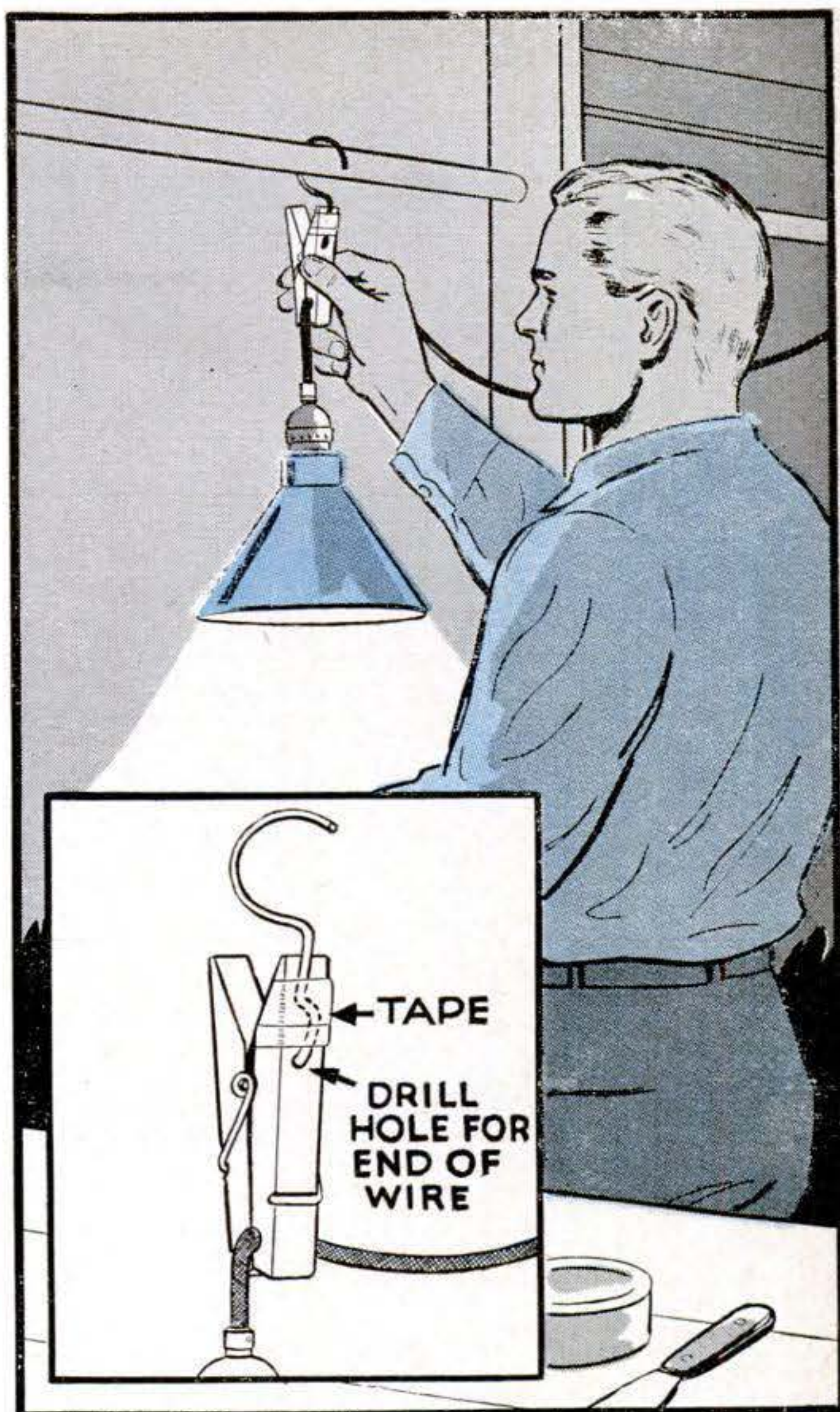
SHIPSHAPE



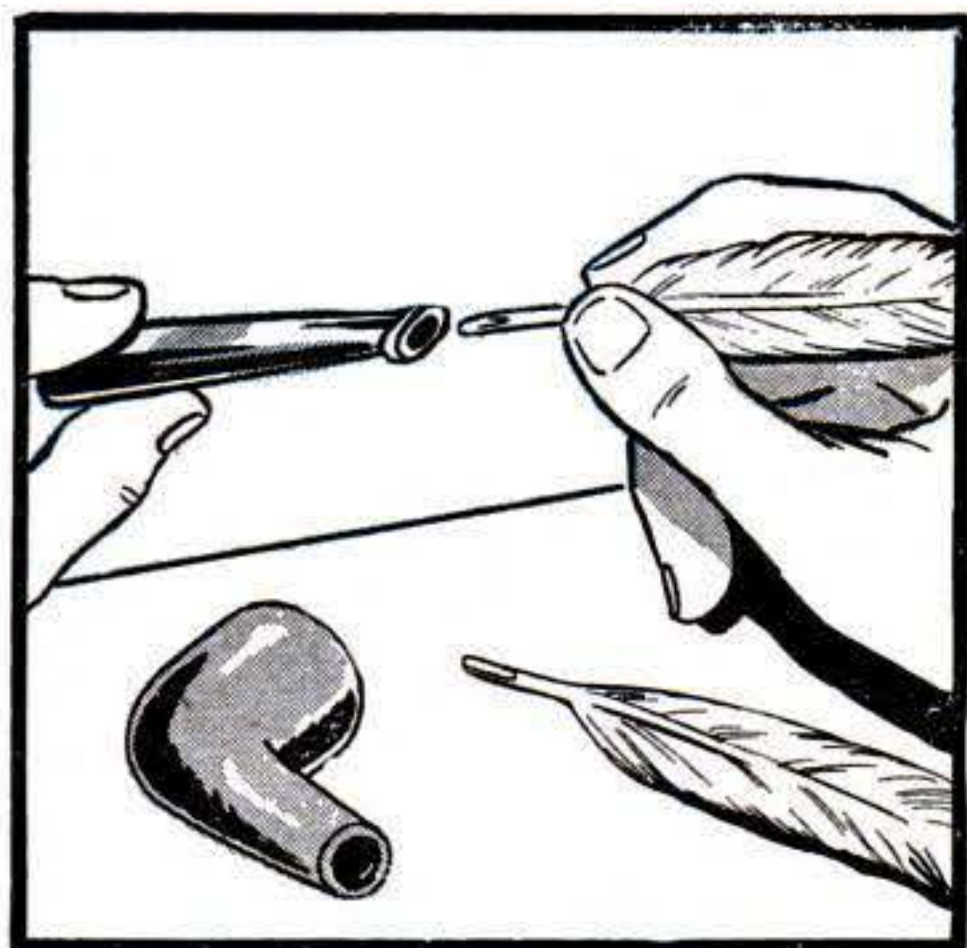
Wooden shelf brackets, because of triangular design, are sometimes hard to fasten firmly to a wall. This can be done by screwing a strip of wood to the back of the bracket so as to extend above and below it as shown here



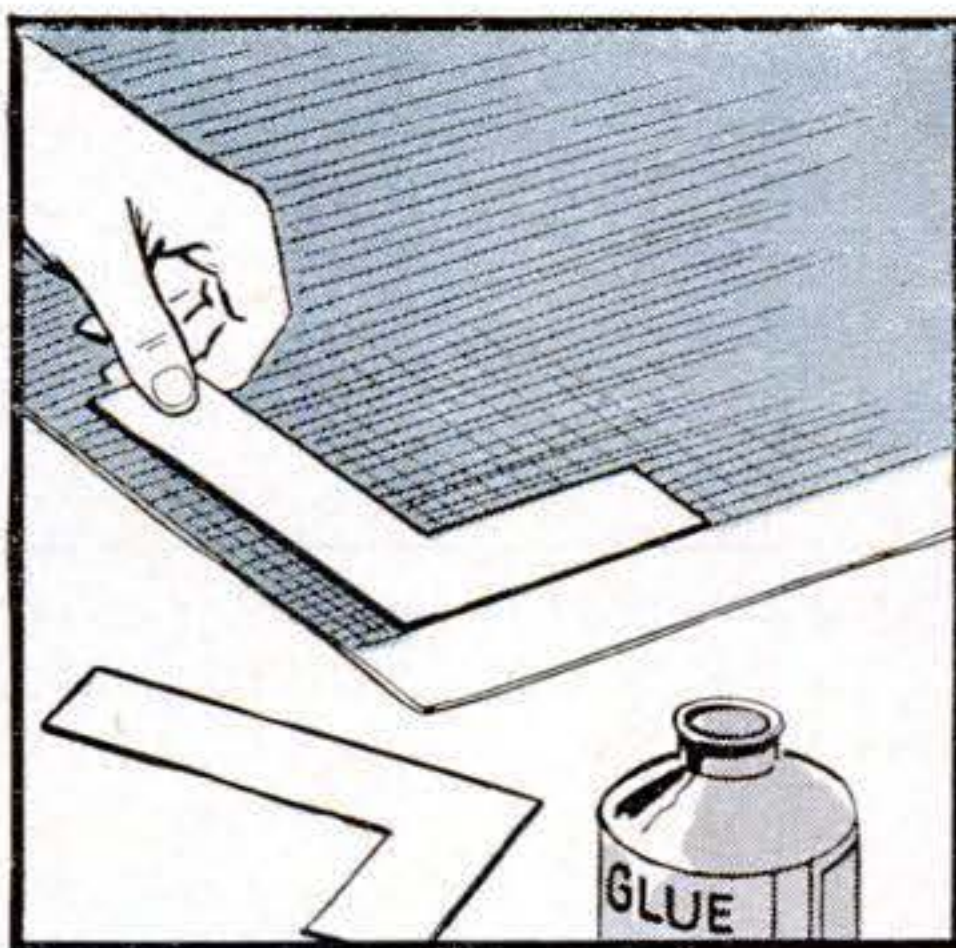
Don't let a cold snap put your water pump out of commission, if such a mechanism is part of your household plumbing. The $\frac{1}{4}$ " pipe connection to the pressure switch will be the first to freeze. Guard this critical point simply with the warmth from a light bulb resting against the connection



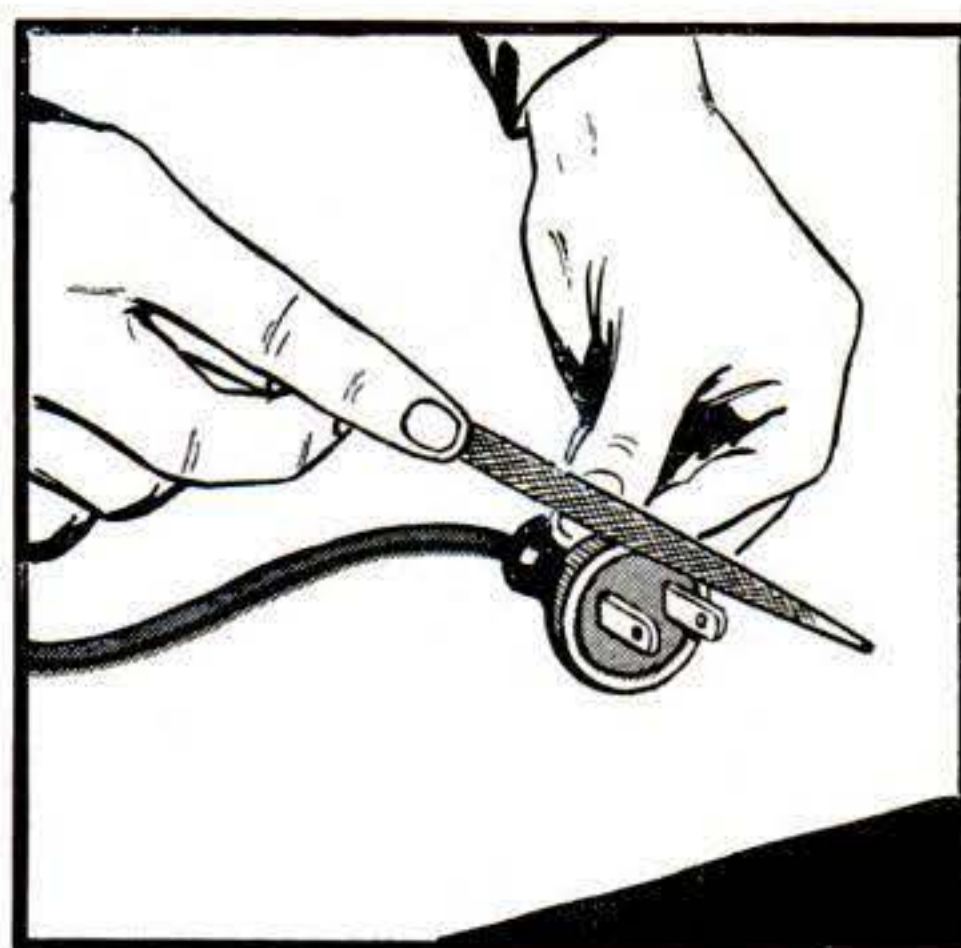
No dark recess of a cellar or attic will be hard to illuminate with a portable bulb and extension cord equipped with a suspension device like the one shown above. This combination hook-clamp will enable you to hang a light almost anywhere. Cut the hook off a wire clothes hanger. In the leg of a spring clothespin, bore a hole to take the shank of the hook, and tape the joint well



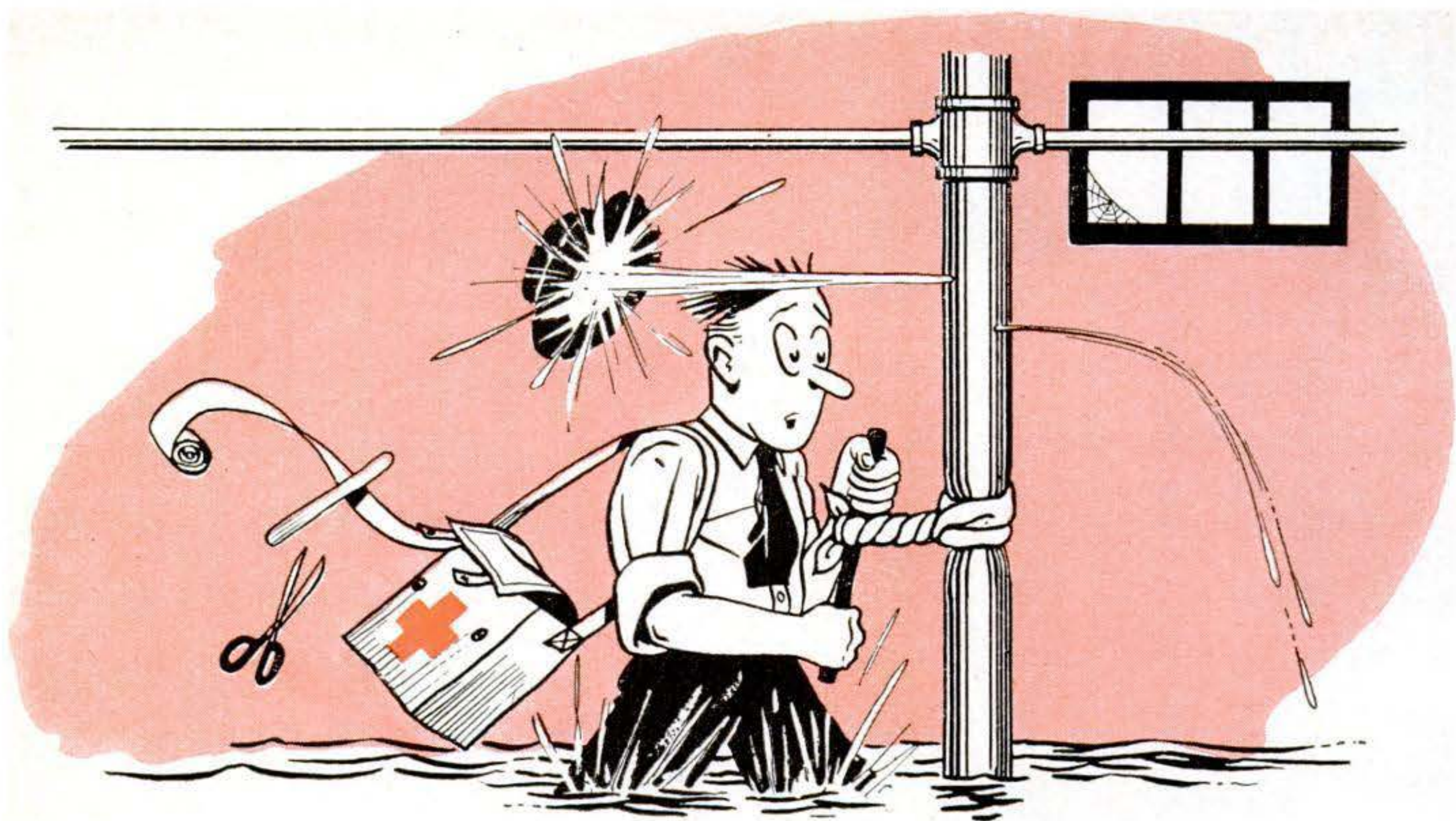
Try chicken feathers in lieu of pipe cleaners if the latter are hard to obtain in your locality. They do a good job if twisted as they are put through a pipe



Curled corners of small rugs will not menace the unwary footstep if L-shaped pieces of cardboard are glued to the undersides. The L's stiffen and flatten the corners



File a flat spot on the top of a light plug so you can feel when the prongs are aligned properly. It will be a help when you insert a plug in a dimly lighted outlet



FIRST AID FOR SICK PLUMBING

By JOHN MODROCH

WAITING for the plumber while the bathroom floods is funny in the comic strips, but in real life it is scarcely amusing. To dodge such an unpleasant situation, it's a good plan to cultivate at least a nodding acquaintance with your home plumbing system. Then you'll not only be able to handle plumbing emergencies, but you'll also be in a position to take care of minor difficulties before they develop into major repair bills.

Cleanliness is of first importance. A faucet, trap, or any other fitting that accumulates scale or waste matter has its capacity reduced continually until actual stoppage occurs. And, no matter when this happens, it will probably catch you when you would rather it hadn't. Open unused faucets occasionally and run off trapped water, drain the rusty water from the bottom of heaters and other storage tanks a couple of times a year, and wipe the sediment from the inside of toilet flush tanks once in a while. Regular attention to such small things as these reduces wear on all parts of your plumbing system by keeping the water free of clogging and abrasive accumulations.

Much of the waste system of your plumbing, unlike the supply part, is protected from corrosion to some extent by the soap and grease that runs through it, but soap and grease cause stoppages in their own

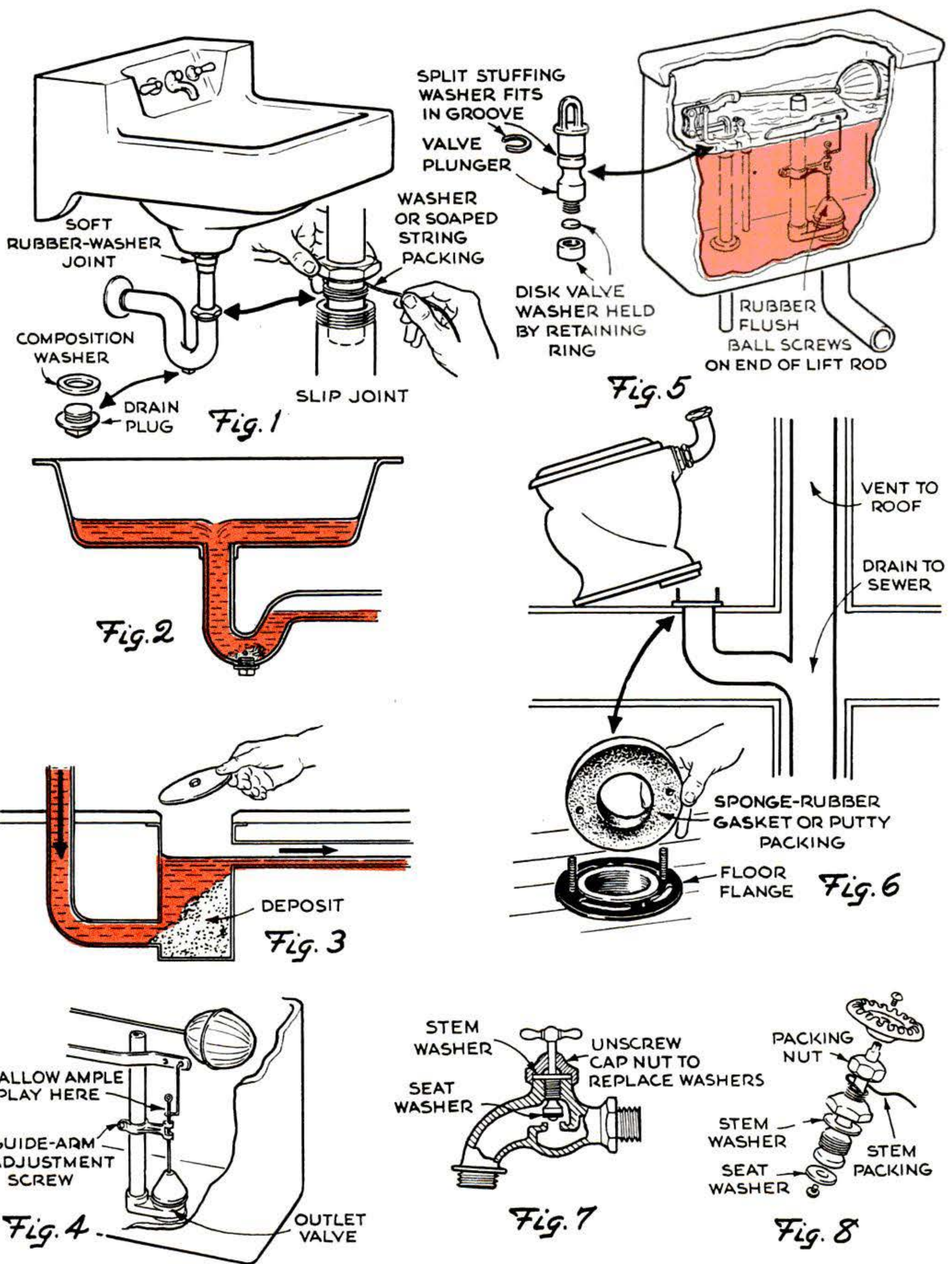
right unless adequately flushed out. Hot water is better than cold for this purpose and, if plentiful, should be used generously, especially in a kitchen sink. Where the supply of hot water is limited, the periodic use of a safe commercial flushing chemical is advisable.

All lavatory and sink traps should be opened and cleaned regularly by unscrewing the drain plug (Figs. 1 and 2), which should be sufficient in ordinary cases. You will find two washer-sealed joints in a plated brass fixture of the type illustrated in Fig. 1. If you must disconnect the trap for any reason, do so at the slip joint, not at the soft-rubber washer joint just under the bowl. The slip joint can be easily reset and repacked, but the joint directly at the fixture is difficult to reset with the original washer.

In numerous instances a lavatory pop-up stopper that is out of adjustment will fail to permit quick draining, or it may leak. Readjustment of the coupling that joins the control rods will correct this.

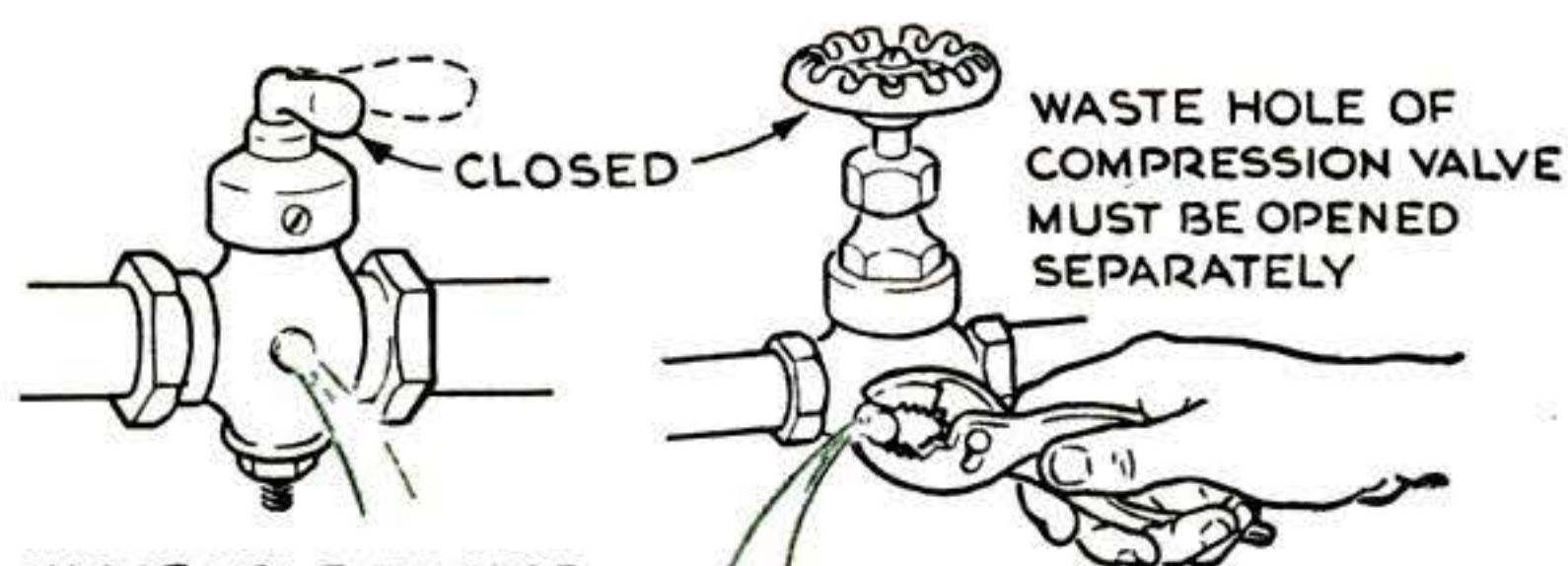
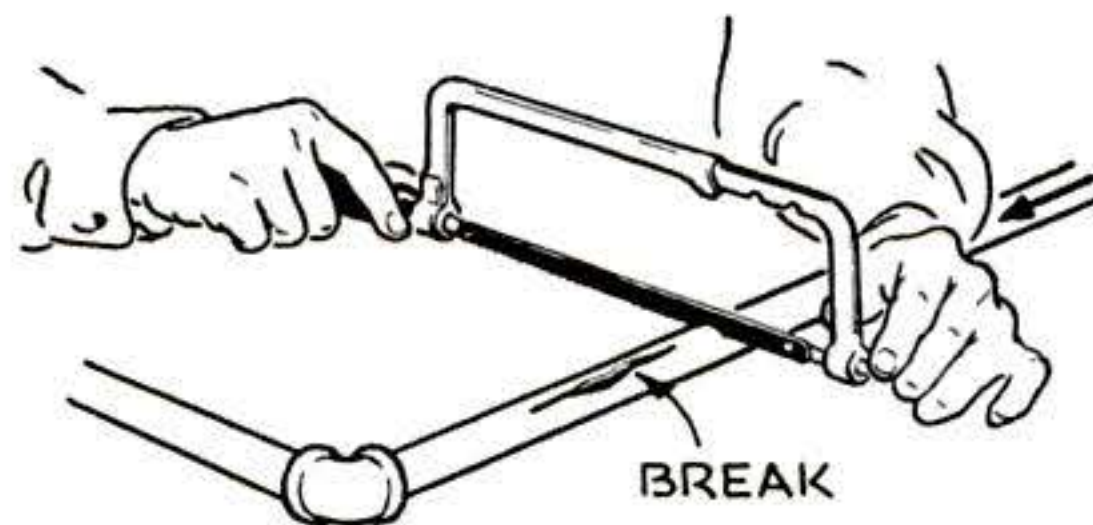
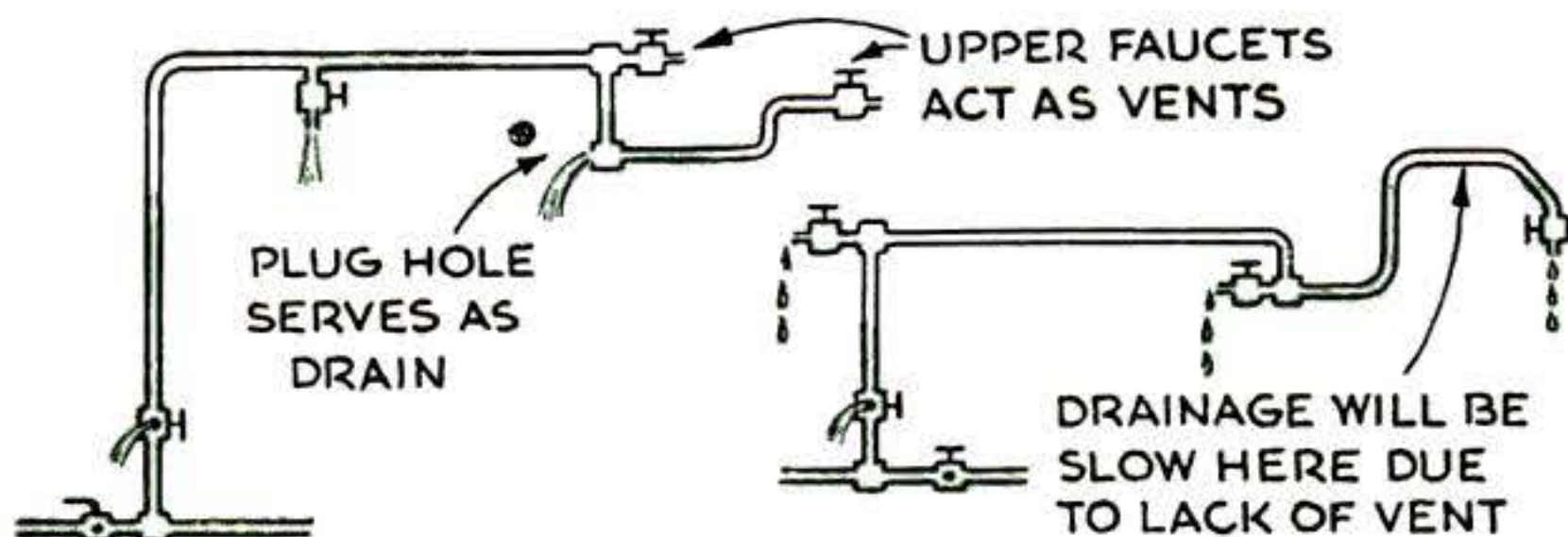
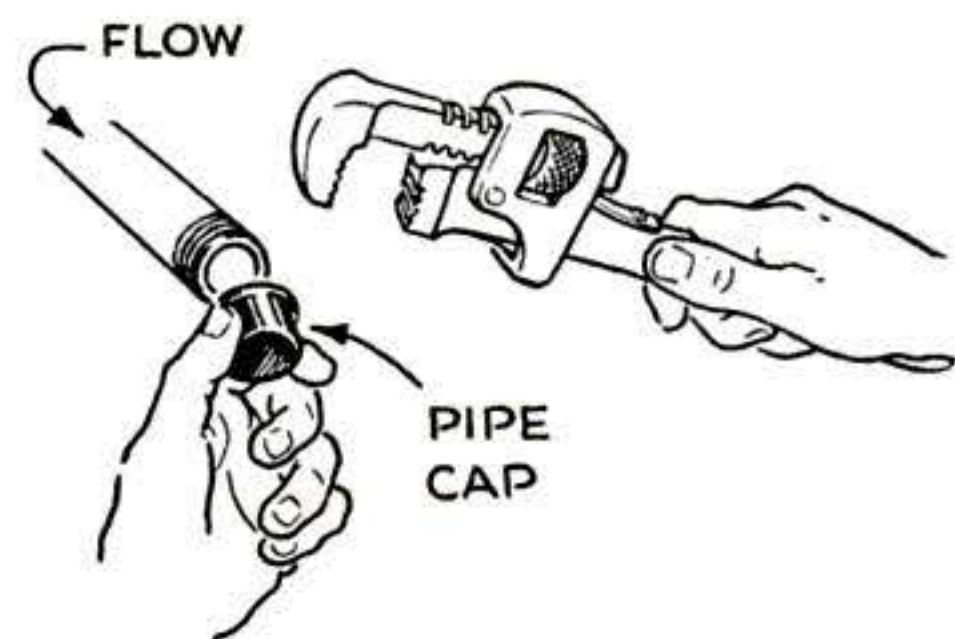
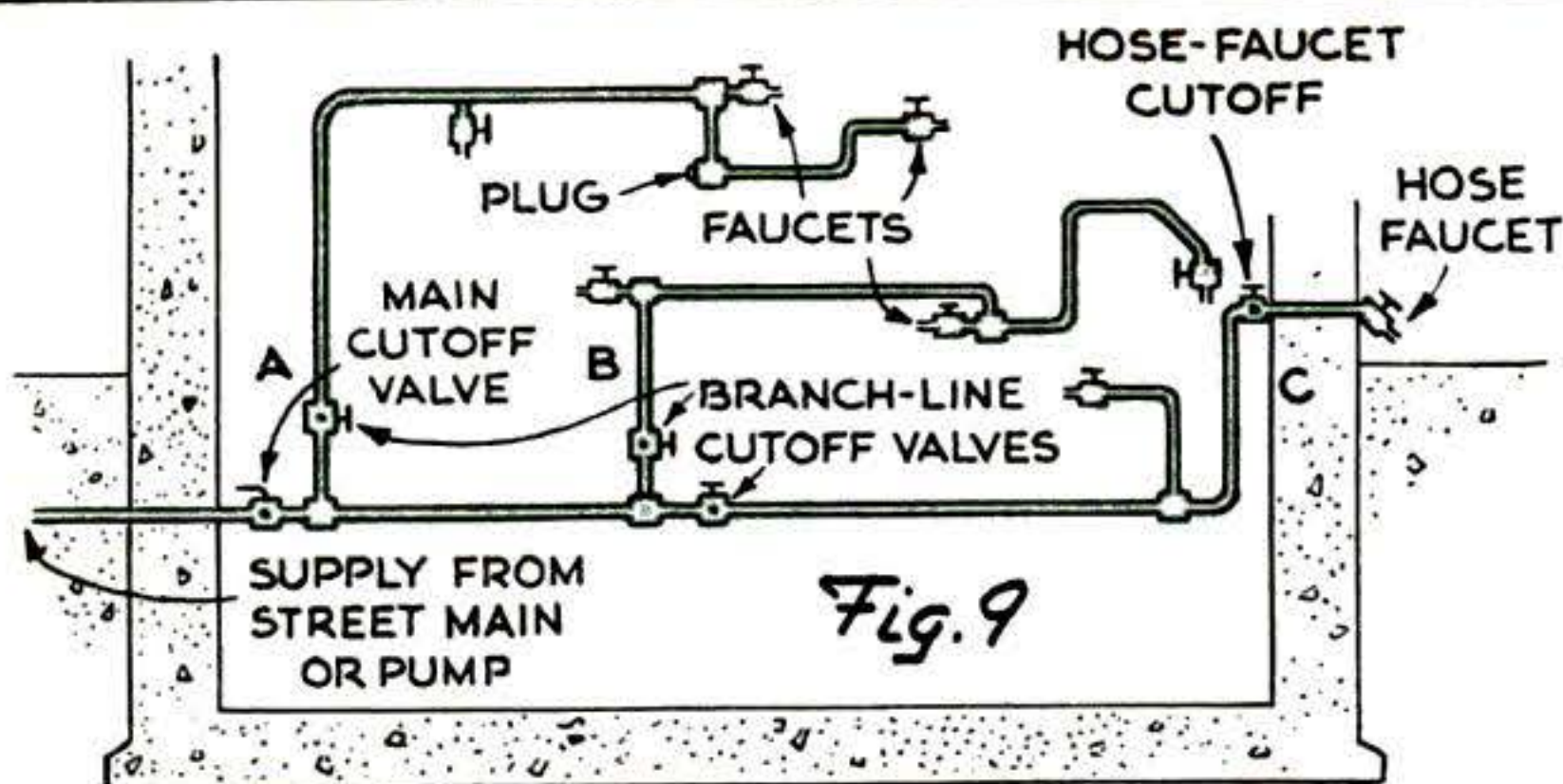
Drum traps (Fig. 3), usually employed in bathtub drains, can be opened, when they are accessible, by unscrewing the top. They should be cleaned out with a spoon. If the trap should be behind a wall having no removable panel, it is important to clean the strainer in the tub often to prevent overloading.

A fixed quantity of water is required for the proper flushing of a toilet. This is re-



leased in a toilet of the flush tank type when the lever controlling the outlet valve is tripped. The tank is then automatically re-filled by the action of the float mechanism controlling the intake valve. If the float action fails to bring the water to the correct level, bend the float rod up or down as required to raise or lower the level.

There are two types of leaks that can be detected by the continuous sound of water running into the toilet bowl. Water escaping down the overflow tube indicates a leak in the intake valve, while that escaping from the outlet valve means a leak past the rubber flush ball. The latter condition is caused by the ball not seating properly and



WASTE HOLE OF STOP AND WASTE COCK OPENS AUTOMATICALLY WHEN COCK IS CLOSED

Fig. 10

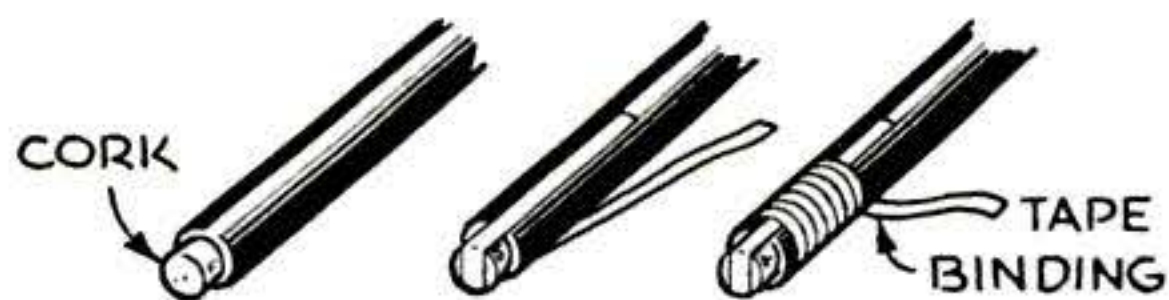


Fig. 13

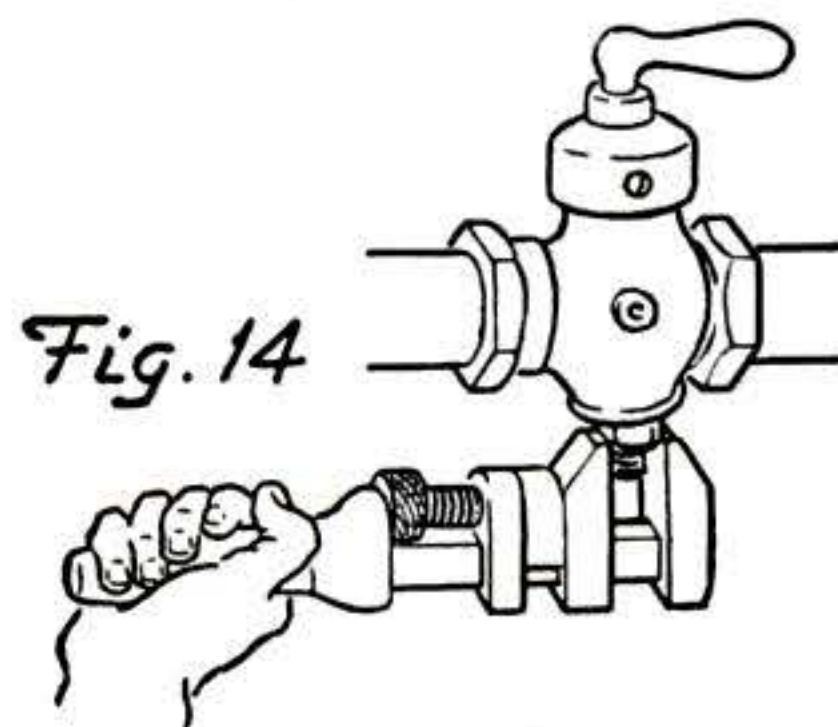


Fig. 14

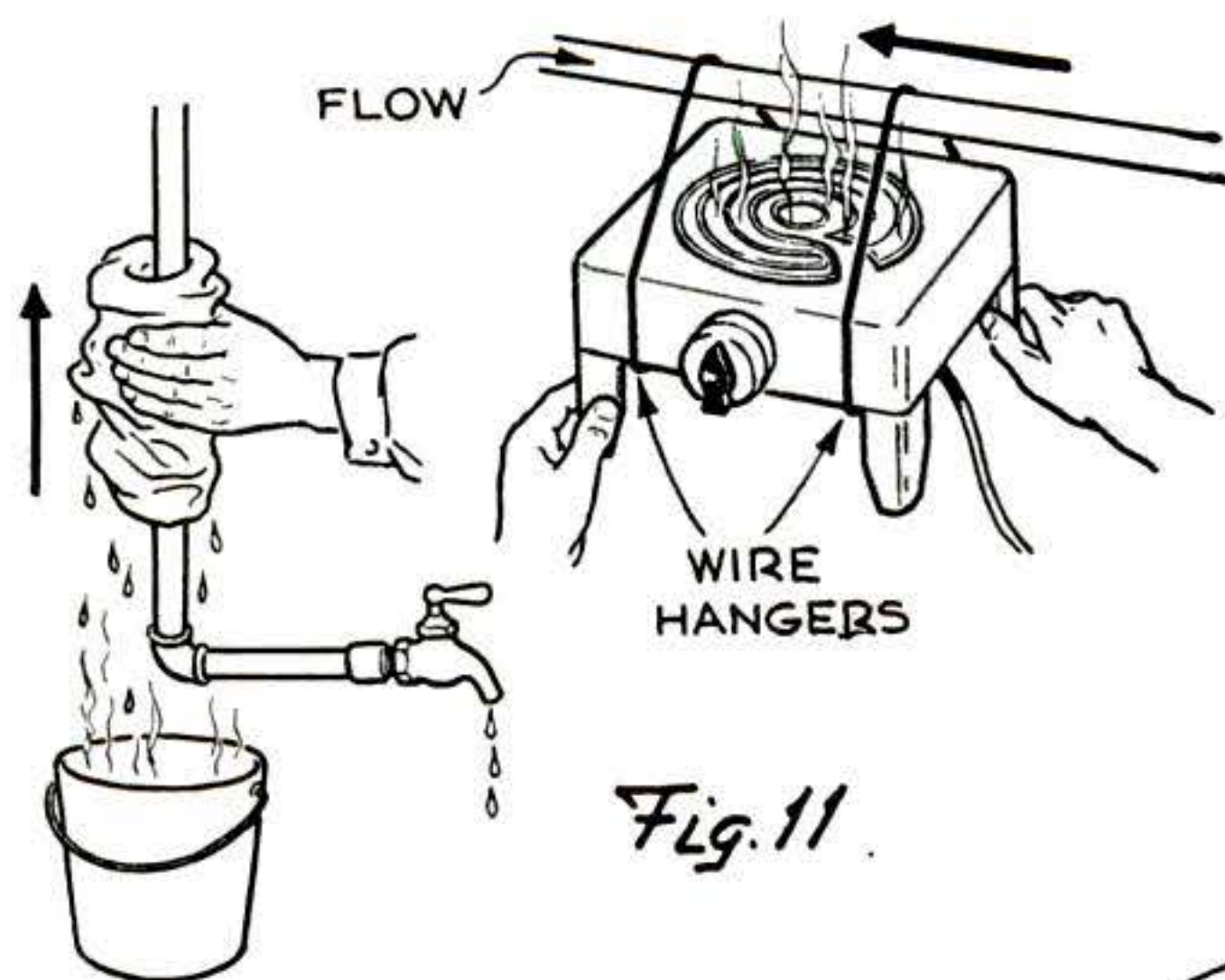


Fig. 11



Fig. 12

sometimes can be corrected by allowing more play where the lift rods are linked together (Fig. 4).

Worn valve washers and the ball can be replaced in a tank by following the directions in Fig. 5. A flush tank of the type illustrated contains a rubber flush ball, a rubber disk washer, and a leather stuffing

washer. The flush ball screws on the end of the lift rod and can be easily removed and replaced. To put in new washers, lift out the intake-valve plunger. The split leather washer fits in a groove, while the disk washer is held by a retaining ring.

A large rubber disk washer, instead of a rubber ball, is used on the outlet valve of



Regular cleaning of lavatory and sink traps prevents stoppages. When a fixture has a cutoff valve, as above, the house water supply need not be shut off

some flush tanks. It is screwed to the bottom of a metal float housed in a shell. When the washer is to be replaced, this shell must first be removed.

The packing in slip joints can be reached for replacement by simply unscrewing the friction ring, or collar nut. This is the same type of joint employed above lavatory and kitchen traps and shown in Fig. 1. A toilet-tank elbow has two of them.

If it is necessary to take up the toilet bowl, remove the flush tank first or you will be unable to disconnect the slip joints. Putty or a sponge-rubber gasket can be used for resetting the bowl on the floor flange, as shown in Fig. 6. Bolt the bowl securely to the flange, for if it remains loose, it may rock and leak at the floor joint. Putty, incidentally, can also be used for resetting the strainer in a sink.

Before most repair work can be done on the supply system, the water must be cut off and, in certain cases, the pipes must be drained. A typical run of supply piping is illustrated in Figs. 9 and 10, which show a simplified cold-water system and

its draining points. A hot-water system is similar except that its supply comes from the water heater. In the arrangement pictured, the branch lines can be cut off and drained independently, which makes it possible to do a repair job on any one of them without putting the others out of service. In draining a branch line, close the cutoff valve and open its waste hole; then open all faucets and other drains in the line.

How cutoff valves function as drains and vents is illustrated in Fig. 10. A vent must be opened at the upper end to allow air to enter and replace the water. If it is not, a partial vacuum is created. This holds the water suspended in the pipes until air entering at the drain can bubble up through the line. When a line is drained to prevent freezing, this situation can prove disastrous.

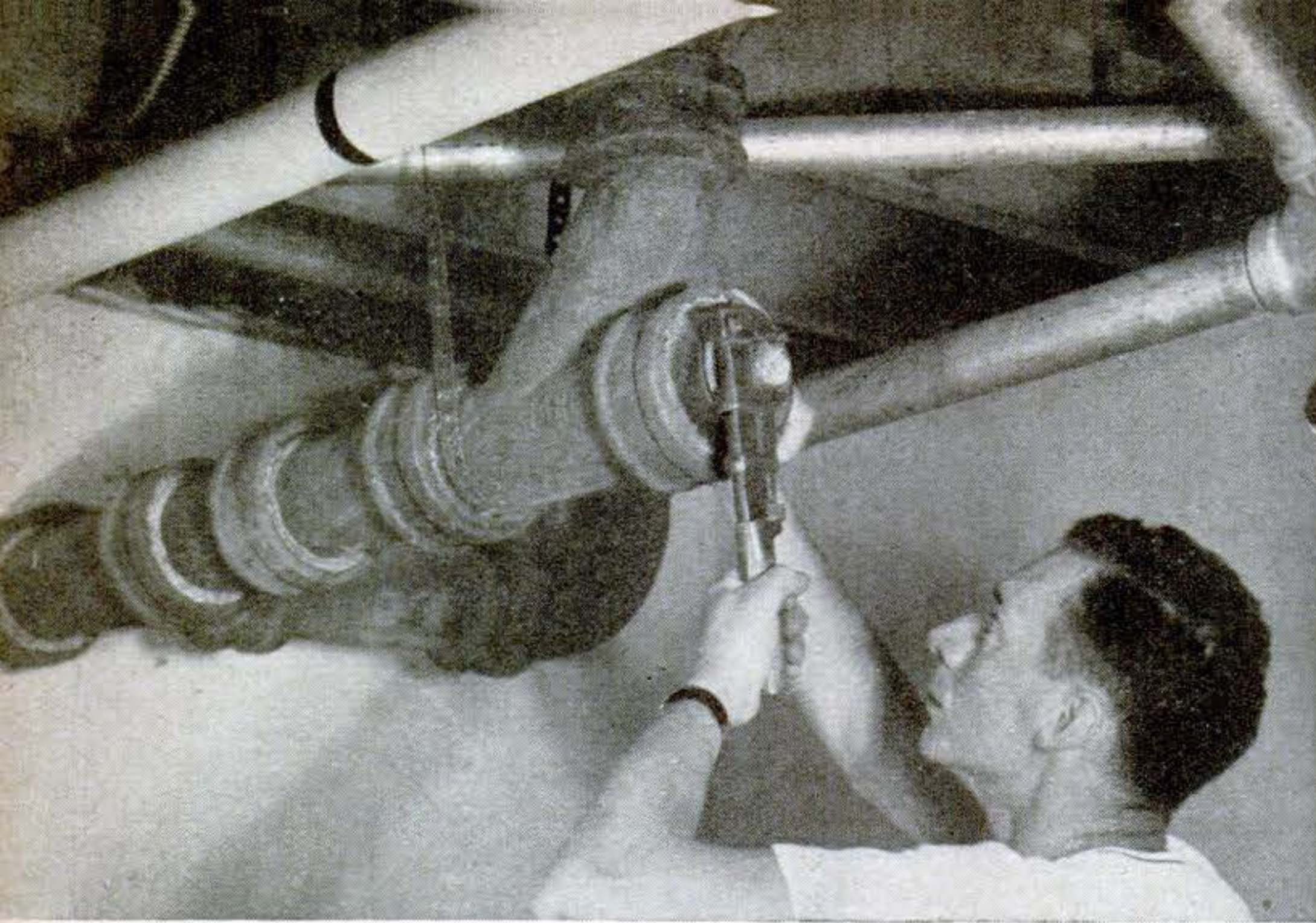
Supply piping is sometimes installed so that branch-line cutoff valves in the cellar can serve as drains while faucets on upstairs fixtures act as vents. In the system shown in Figs. 9 and 10, however, the condition existing in the branch line at A makes it necessary to remove the plug from the tee located at the drop in the line in order to drain this section. Because of the unvented gooseneck in the branch line at B, drainage of this section will be slow.

By hanging numbered tags on the cutoff valves and draining fittings, and listing them on a schedule giving their locations and the lines they control, you can save time when a repair is necessary. This will also guide anyone called upon to service or repair the plumbing in your absence.

When a common compression faucet

Tags on the cellar cutoff valves and a list of the lines they control will save time when an emergency repair has to be made





When access must be gained to the soil pipe leading to the sewer, the brass plug should be removed from the clean-out Y with a heavy wrench

(Fig. 7) drips, look for the trouble in the seat washer. To replace this washer, unscrew the cap nut, turn the stem until you can lift it out, and remove the brass retaining screw holding the washer. If this screw is badly corroded, it also should be replaced. Never force a new screw if it begins to turn hard before it seats the washer, as the threads in the stem hole may be corroded and may cause the screw to twist off. Clean out the threads with a tap of the proper size, or shorten the screw by filing off the end just enough to allow it to be turned down tightly and to seat the washer.

To stop a faucet from leaking around the stem, try tightening the cap nut. If this doesn't work, replace the stem washer. This may be done without cutting off the water pressure. Simply remove the handle, unscrew the cap nut, and lift it off the stem. The seat washer keeps the water from flowing.

A compression cutoff valve is fitted with stem packing in addition to a stem washer, as shown in Fig. 8. Packing in good condition requires little pressure from the packing nut to make a watertight joint. Put in new packing when the old one is so compressed that the packing nut must be turned down hard to stop a leak.

Sometimes a leak in a stop-and-waste cock can be halted by tightening the nut at the bottom of the valve, as in Fig. 14. Tighten it just enough to stop the leak without binding the valve so that it will not turn.

Attention to these details in your periodic check can prevent serious trouble. However, should a hard accumulation be caught in the pipe beyond the trap, snag it and pull it out. Short coil-spring augurs having a hooked end are made for this purpose. Some are equipped with a crank handle, which

should be turned clockwise both while feeding the augur in and while withdrawing it.

Flat spring-steel sewer rods are available in various lengths suitable for working in the soil pipe leading to the sewer, access to which can be gained through the clean-out Y shown in Fig. 12. A length of armored electric cable, with one end of the metallic sheathing unwound slightly to form a hook, can sometimes be used successfully. The clean-out Y can also serve as an emergency outlet for that part of the waste system above it should a stop-

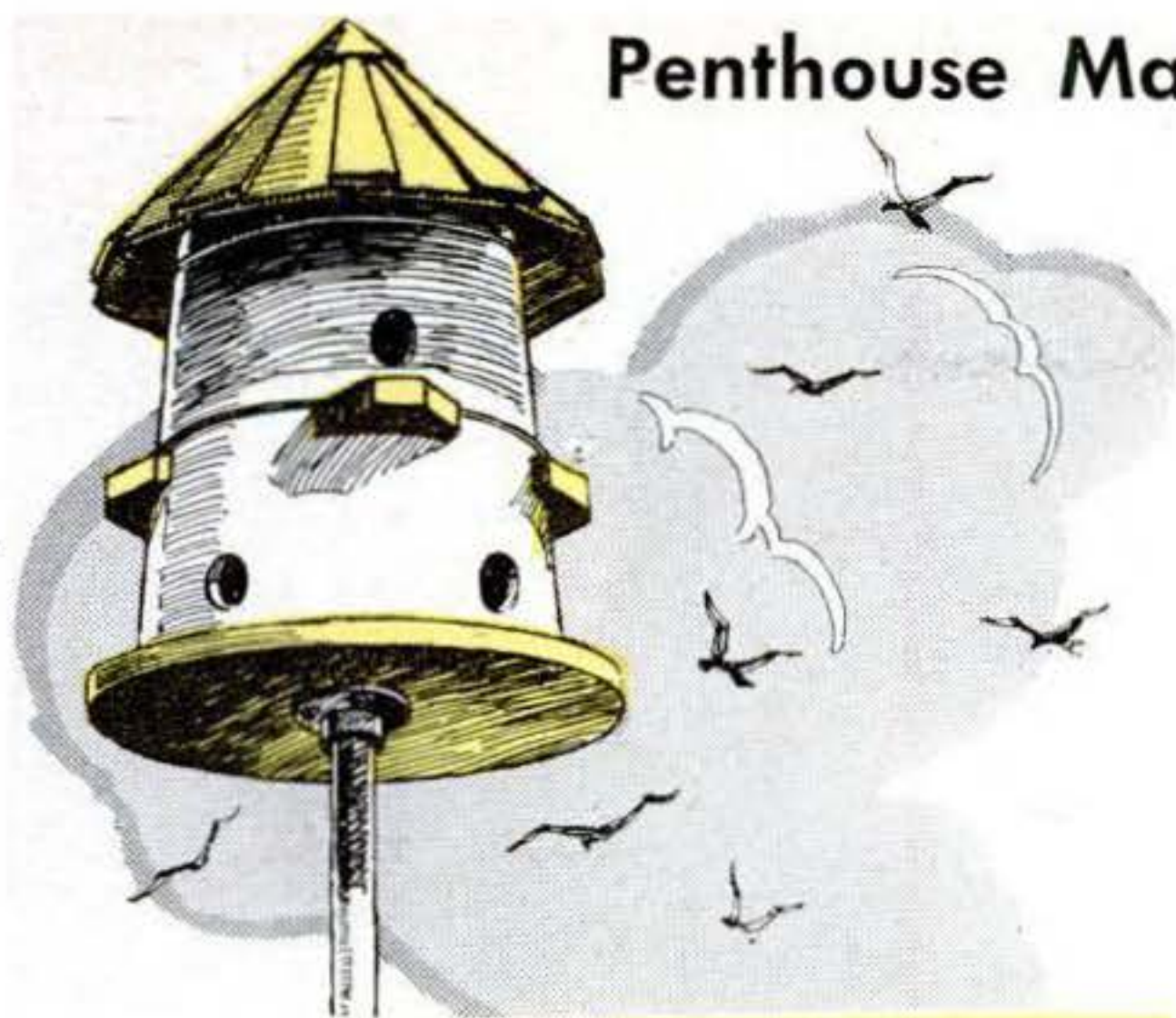
page in the soil pipe be too difficult for you to remove.

During extremely cold weather, it is, of course, wise to take some precautions against the freezing of plumbing that is not fully protected. Open windows in a bathroom or kitchen are a danger to fittings and exposed pipes that stand close by. Cellar doors, especially cellar garage doors, should close tight. In partially heated quarters, it is advisable to let a faucet drip during very cold nights in order to keep the water moving in the pipe. Hanging a light bulb against a vulnerable pipe or fitting will also prevent freezing in some cases. If a house is to be closed with the heat shut off during cold weather, all pipes should be drained, and it is wise also to put a little antifreeze in traps that are hard to reach.

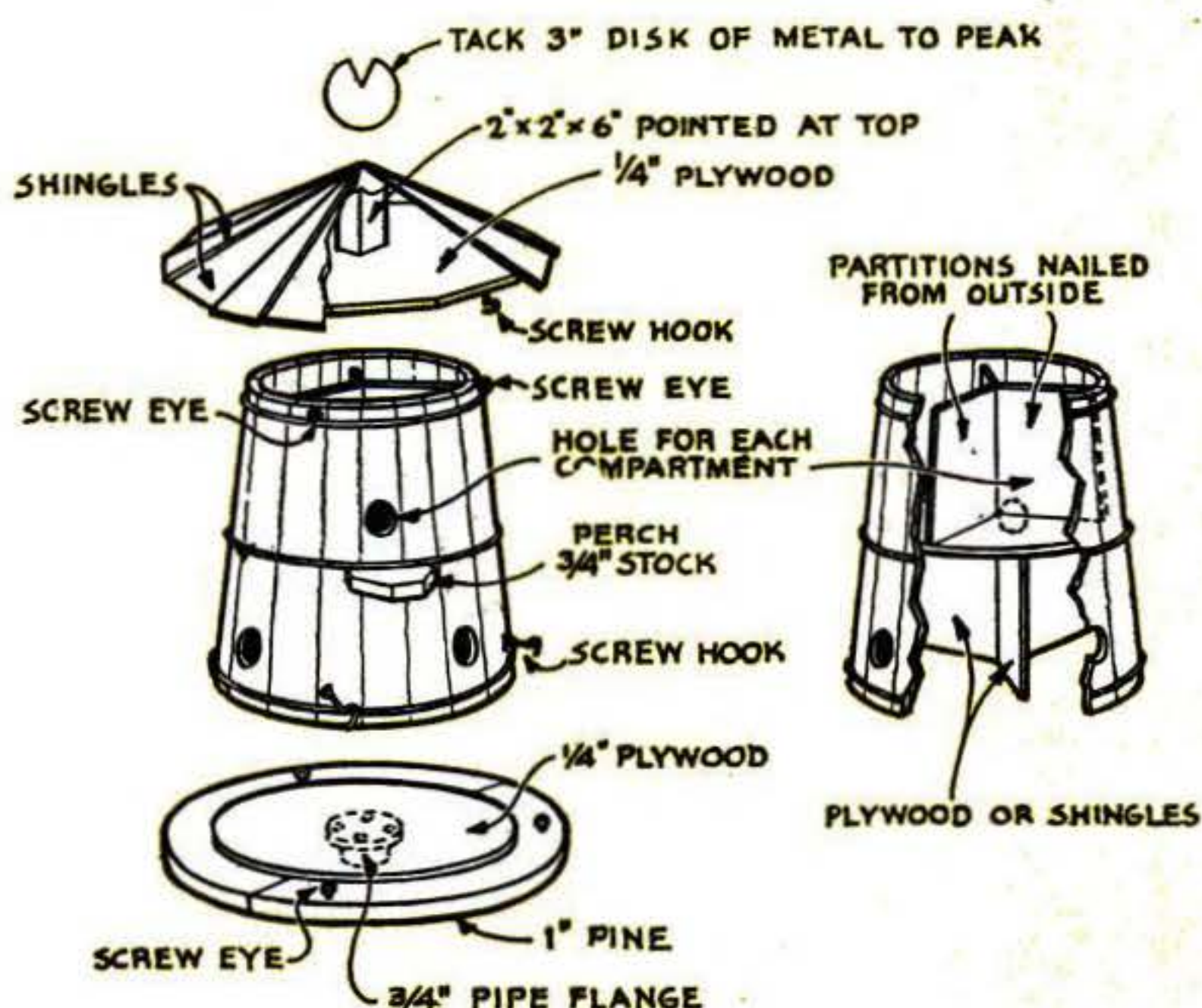
In thawing a frozen pipe, start heating at the faucet end and work toward the main supply line, as in Fig. 11. Leave the faucet open to permit the thawed section to drain, and keep the pressure on to assist in breaking up the ice once it becomes slushy. As a precaution against fire and to avoid the possibility of bursting the pipe with sudden, intense heat, apply only slow-heating methods, such as hot bricks, towels soaked in hot water, and electric heaters. If a blow torch must be used to speed up a job, play the flame back and forth to spread the heat.

Should a leak occur, an emergency repair can be made with a coating of roofing cement or calking compound. Bind it with friction tape or a section of garden hose held securely with hose clamps. A damaged pipe line may be put into temporary use, as in Fig. 13, by removing the broken fitting back to an accessible threaded joint and screwing on a pipe cap, or by sawing off the pipe above the break and plugging it.

Penthouse Made from Pail Lures Aerial Tenants



BY KNOCKING the bottom out of an old wooden bucket, you can easily make a cozy penthouse to lure avian house hunters. Into the bucket, fit a disk of $\frac{1}{4}$ " plywood halfway down. Partition the upper and lower stories into three compartments each, arranging them so that none of the entrances, which are bored through the bucket, is above another. Leave a 1" space between the partitions and the top and bottom of the bucket. A circular base 6" larger than the big diameter of the bucket is made from 1" pine.



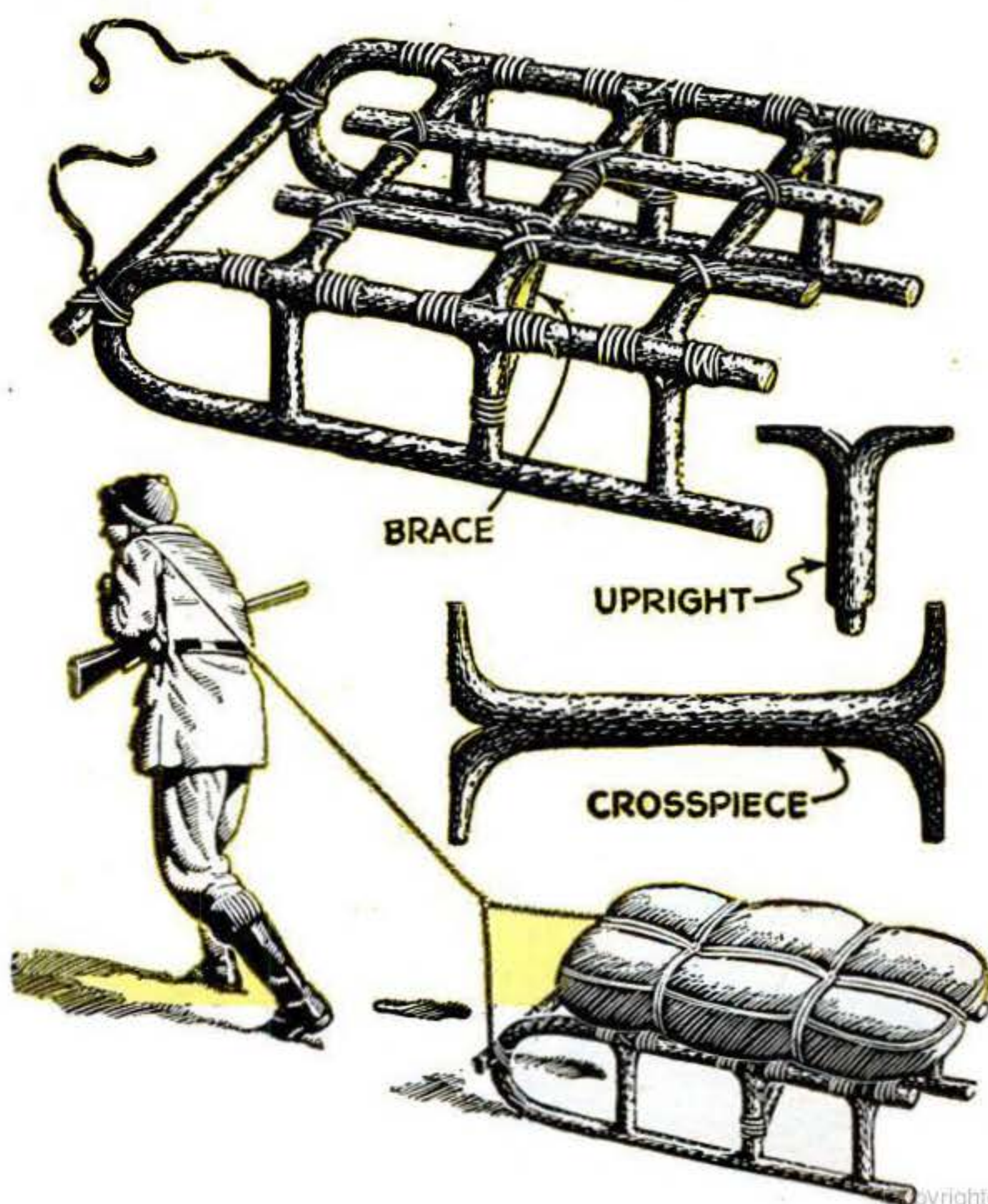
Make the ceiling a decagon of the same diameter as the circular base. Fasten to it a 2" by 2" by 6" block with a cone-shaped upper end; then attach a double layer of wedge-shaped shingles. Cover the peak with tin to shed rain. Screw eyes and hooks hold the bucket to both the roof assembly and the base so that the house can be taken apart for cleaning.

To set the house on top of a threaded pipe, screw a $\frac{3}{4}$ " pipe flange to the bottom of the base. If it is to be suspended, put a heavy screw eye through the tin peak into solid wood and daub roofing cement around the screw-eye shank.—J. A. EMMETT.

Forest Supplies Materials for This Indian Emergency Sled

A CHIPPEWA Indian sled may prove a lifesaver in case of injury to a companion along a rugged trail. Ash is the best wood to use since it will bend without breaking when green. Form the runners from two branches and bore six holes in them for the uprights, which are cut and shaped to fit the holes after being partly split at the top. Install the rear uprights first, thus binding the runners in shape and making it easier to set in and fasten the forward uprights.

Lash the front spreader in place. Form three crosspieces, as shown in the drawing, and lash them together with the other members of the sled. Finally, lash two straight sticks lengthwise on top of the crosspieces. If no cord or hide is available, bark strips from ironwood or laces pulled from the boots of the injured man can be used as thongs.—GRAY WOLF





New Home Movies For Old

HOW TO EDIT YOUR FORGOTTEN FILMS TO GET ADDED ENJOYMENT

By CHARLES CLARKE, A.S.C.

WITH many a maker of home movies, the completed films are the Cinderella of his hobby. His camera and projector are treated like the precision instruments they are, but his films are just tossed into cans and left to fend for themselves between showings.

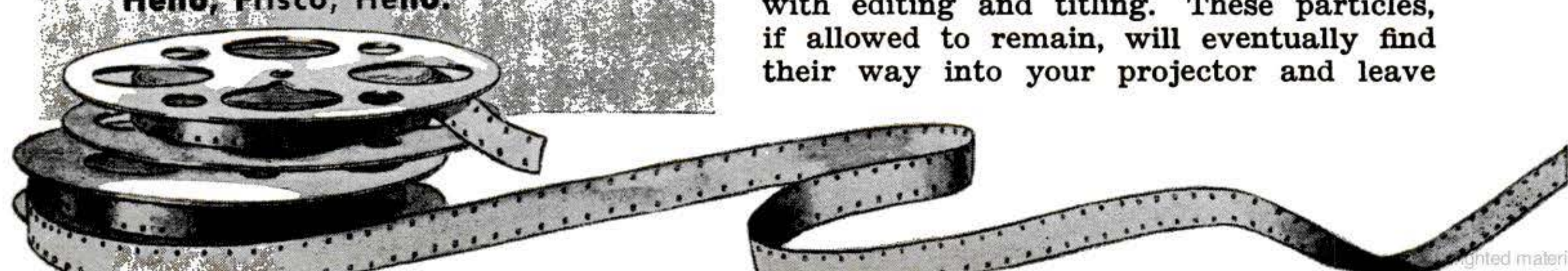
Such photographers often seem to forget that the films are the end for which they have labored, whereas the equipment is merely the means. They must be handled as carefully as the camera and projector themselves, and they must be kept just as

clean. If they are, you and your friends will derive increased pleasure from them, and you will be able to keep that enjoyment alive for a much longer time.

It is really an easy matter to keep films showing perfectly for years, if you only know the rules—the few simple ones employed at the professional studios in Hollywood. They sum up to keeping clean those parts of your camera and projector that touch the film in the making and in the showing, and to keeping the film itself clean. The result is that dirt, oil, and other foreign substances will not scratch or cloud the frames.

You want to be sure, first of all, that the camera lens is clear and clean for every shot. Wipe off dust particles, moisture, and fingerprints, preferably using a soft brush. While such accumulations may not actually injure the glass, their presence will diminish the clarity of your pictures. If the lens can be removed, also clean the rear element. The gate must be cleaned as well; otherwise bits of emulsion that collect there may scratch the film or cast shadow images.

Any approved cleaner will remove from the developed film the inevitable dust, fingerprints, and bits of cement that come with editing and titling. These particles, if allowed to remain, will eventually find their way into your projector and leave



Dividing his interest between Twentieth Century-Fox studios and his home laboratory, Charles Clarke has made more home movies than professional ones, and he brings you experience gained in both roles. He worked as chief cameraman on such recent films as "Careful, Soft Shoulders," "Moontide," and the technicolor musical "Hello, Frisco, Hello."

streaks of black on the emulsion. Draw the film slowly through a cloth that has been dipped into the cleaning fluid and wrung out to remove the excess. This may be done on a rewind device with the cloth held near the first reel. Wind slowly so the cleaning fluid will evaporate before the film reaches the rewind reel.

After it has been cleaned, the film should be stored on a large rustproof reel, not on a small reel of the type used by processing laboratories in returning film to their customers. Storage space can be conserved by splicing several sequences together for winding on the same reel. Place each filled reel in a suitable film can that will close out all light, and keep it in a closet or a bookcase where the film will remain cool, dark, and dry and stay pliable. Should film become brittle, however, it can sometimes be restored by being put in a covered bowl with a moist sponge, but do not let it touch the sponge.

Color film needs even more careful treatment because of the additional danger of its colors fading. In fact, the makers of this type of film warn that the normal color balance can be best retained when the film is stored in a cool, dry place—at a temperature of no more than 70 deg. and a humidity of less than 50 per cent.

No matter what precautions you take, your sequences will eventually begin to show signs of wear, but don't throw them away. Spend an evening reviewing the older pictures, select the scenes you would like to preserve, splice them together, wind them on a large reel, and send them to a film laboratory for duplicating. When they are returned, store the originals in a safe place and use the duplicates for projection.

Most amateur camera-

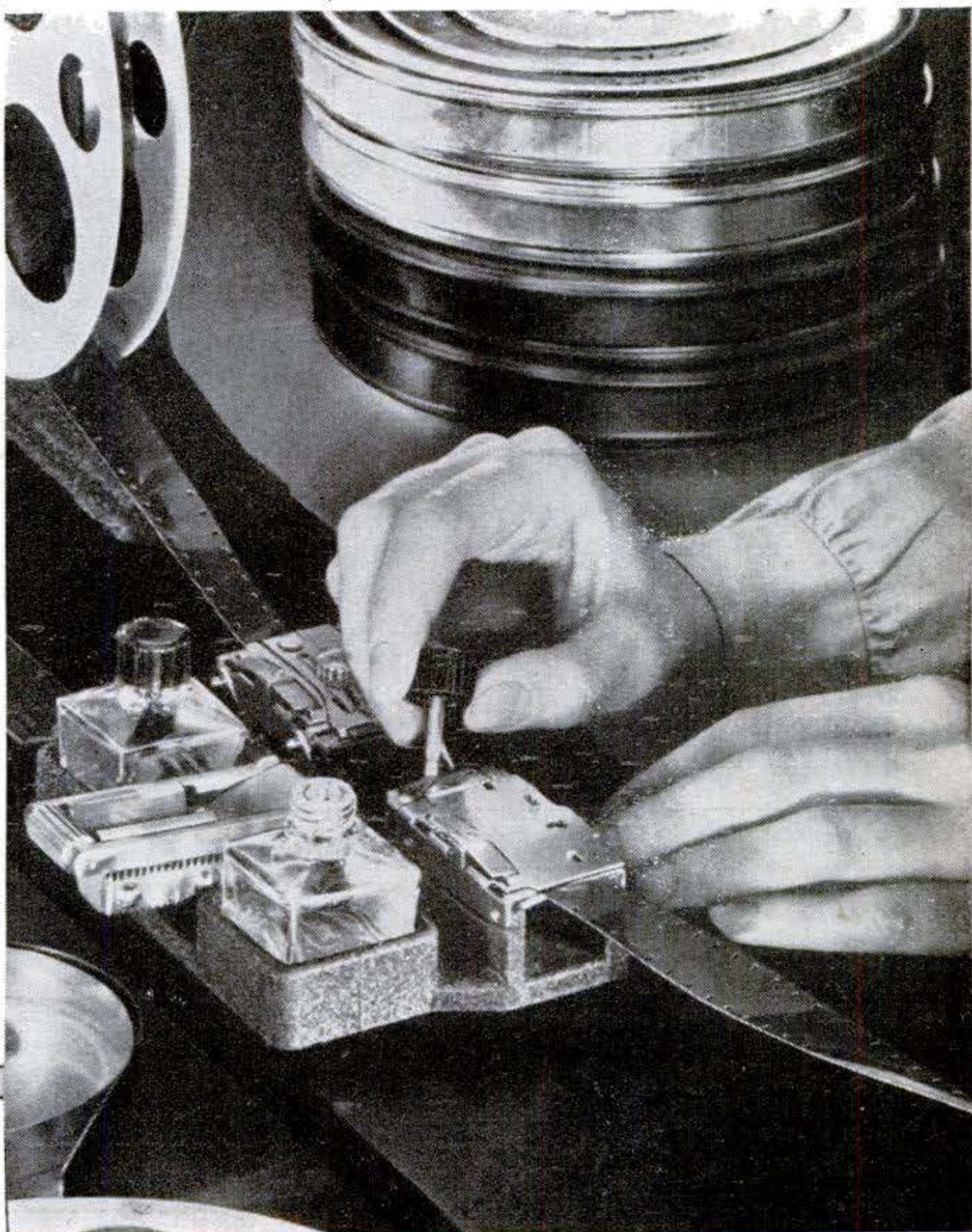
After cuts have been made, trim the ends of the good film, take off the emulsion with water and scraping, and splice with cement

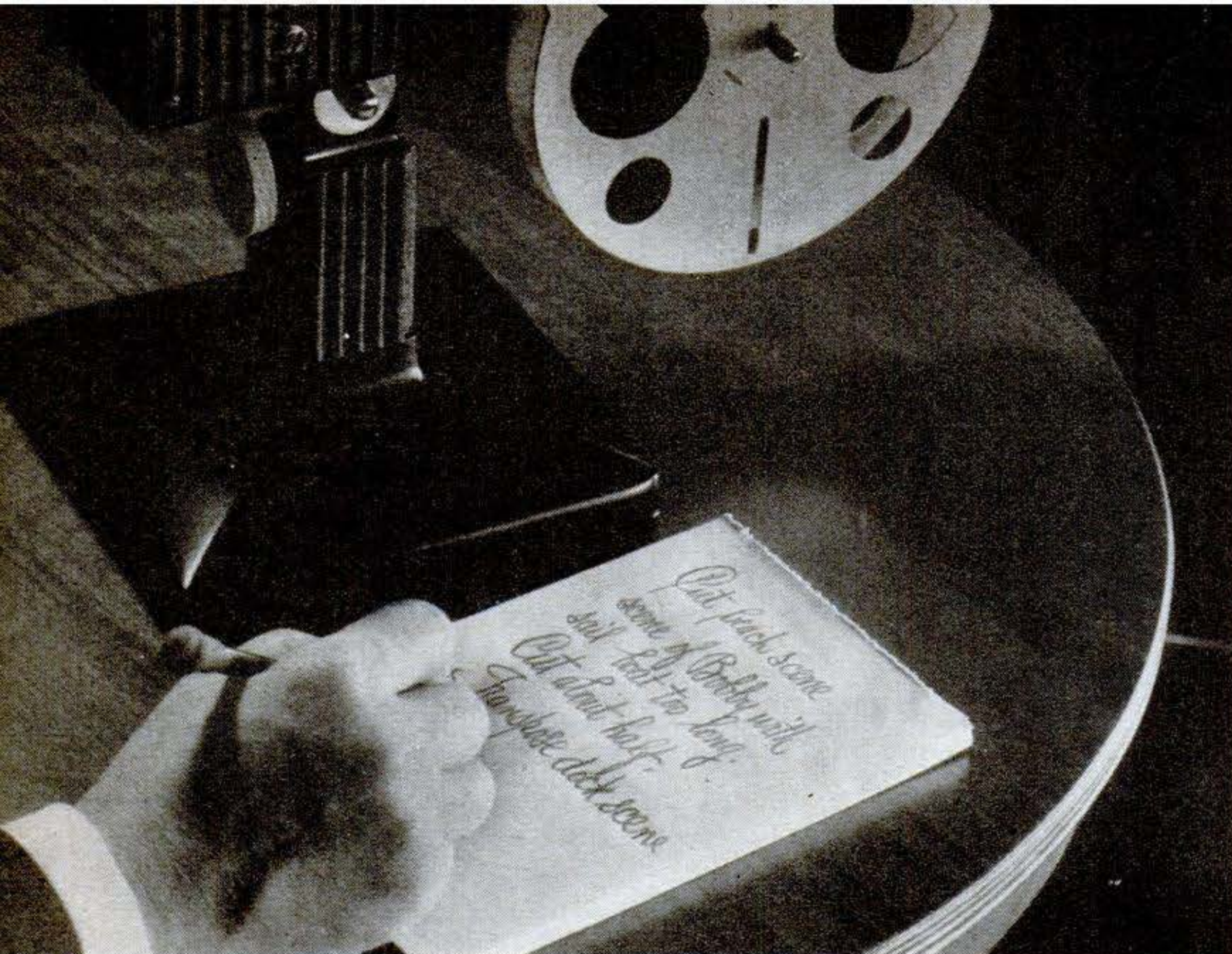
men have considerable good footage from past years that requires hardly more than a little judicious editing to be put into shape for interesting showing. Unrelated scenes may have been spliced together haphazardly with the thought that some day they might be edited and titled. Why not do this job now? By using only the better scenes and a few appropriate titles, you can create, during one or two evening sessions, reels that will provide many evenings of pleasure.

Think of the picture to be edited as you would of a story you wish to tell in an orderly and attractive way. Employ only interesting episodes and weave them into a logical sequence.

First, assemble the equipment you will use: movie viewer, rewind and splicing block, projector, screen, paper, pencil, and the film to be reviewed. Set up the projector and screen, and run the reel through. Just watch the screen this first time, taking no more than mental notes of the interesting episodes and the quality of the film. Then rewind the reel and run it through again, taking notes with a pencil.

Suppose the picture carries the family





Scene-by-scene notes jotted on a pad as the film is projected will be a big help when it comes to making cuts later on the viewer

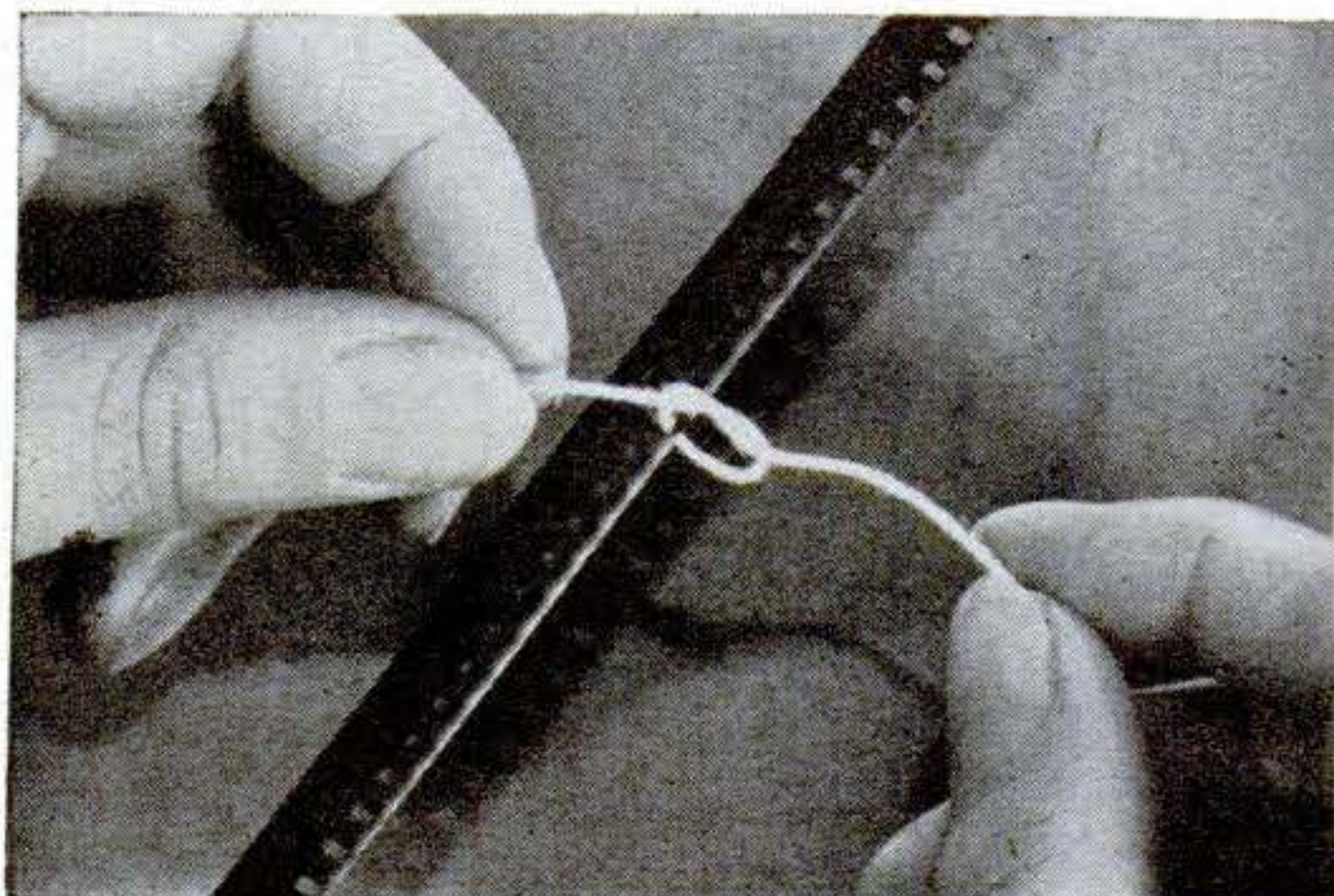
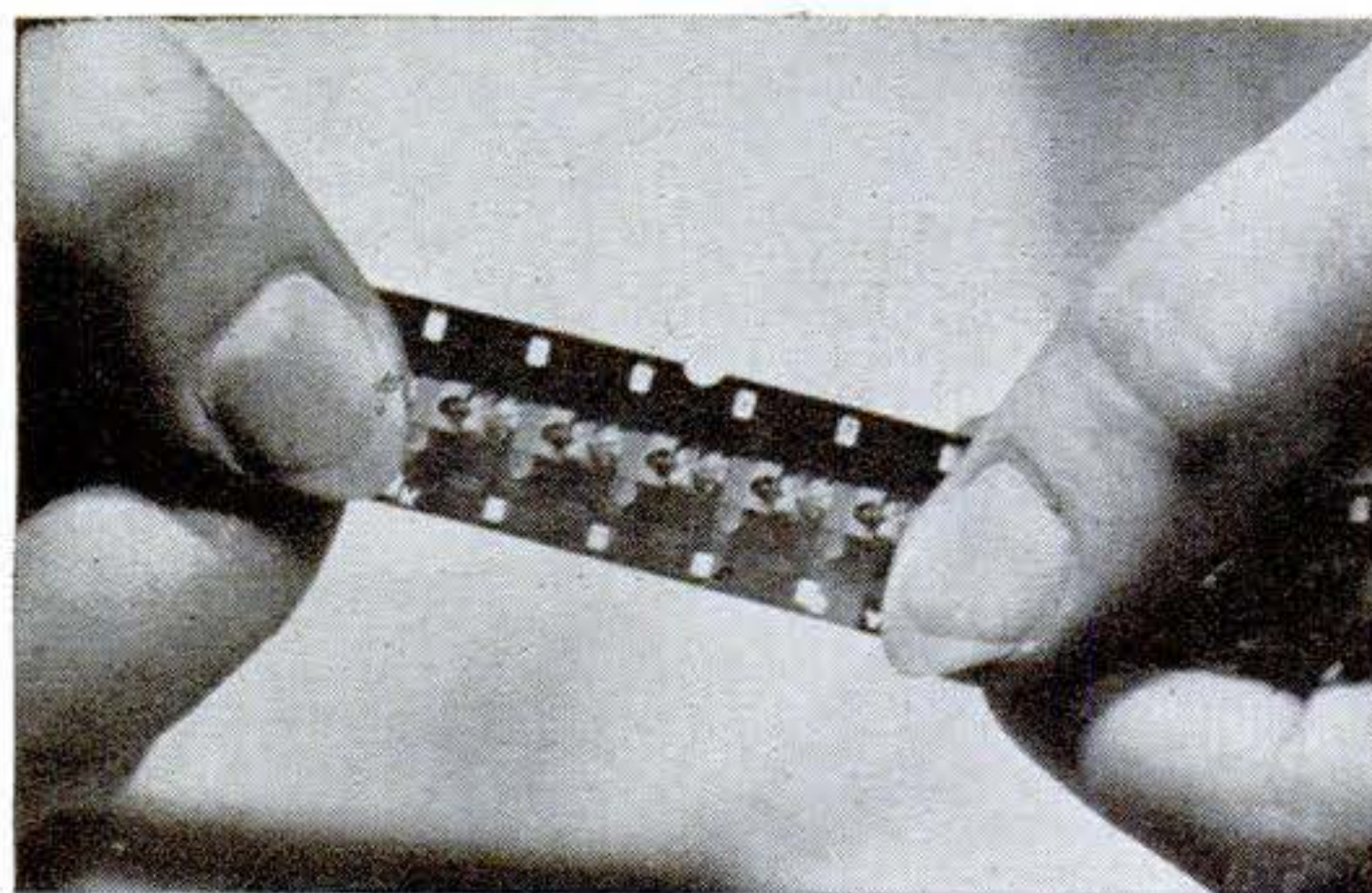
Sections of film to be cut may be identified with snips in the edge of frames, as shown in the first photo below. Points for inserting titles can be marked with tape or string

through a back-yard party. Your notes will unfold something like this: "Children waiting on back porch . . . cut delay before they race to barbecue. Little Bobby walks out side door carrying toy sailboat . . . scene too long. Jim cooking meat . . . O.K. Mother and sister setting table . . . good, but cut first part, underexposed. Janet serving meat . . . excellent. Father eating . . . good. Henry and sister struggling with large sandwiches . . . good, but cut where camera jiggled."

With these notes at your elbow, rewind the film and start it through the viewer. You want to eliminate some of the delay on the back porch. Wind the film slowly through the viewer until you reach the point for the cut; then press the lever at the gate and snip an identifying mark on the edge of the film. Continue winding until you reach the end of the undesirable section, and snip the edge of the film there.

Before going further with the viewing, tear out the undesirable footage and splice the good film. This will save time in the end and be assurance against mistakes that are likely to be made in helter-skelter reviewing of an entire reel and an attempt to remember all the cuts.

In splicing, place the torn ends of the good film on the splicing-block pins and swing the shearing arm down, trimming both evenly. Touch a moistened brush to the ends to loosen the emulsion, and then draw a scraper across the edge to remove it. Spread cement over the cleaned edge with a brush, swing the lever controlling the end of one good section of film, moving it firmly down over the other, and pressure plus cement will complete the splice.



The rest of the job is largely repetition of this first step. Where the viewer reveals sections that should be removed, mark them with identifying snips and remove them, continuing until you have reached the end of the reel.

Sometimes a rearrangement of scenes will produce greater interest—a mixture of comedy and straight shots is often very effective. Don't hesitate to make whatever changes you think will be an improvement. It's the total effect that you want, and your changes should be made with that in mind.

Don't close the sequence with an underexposed scene taken in late afternoon. It always adds a sour note to what otherwise is an enjoyable record. Why not splice in a beautiful sunset from some vacation footage for the conclusion?

Determining where to put in titles depends to a large extent upon your personal desires and the nature of your picture. In general, the fewer the titles, the better. They should not be too wordy, and you should give them enough time to be read easily. Titles are useful to explain shifts in scene or to indicate a passage of time, but opening scenes often serve adequately to label all those that follow. Two or three shots of meat being taken from the refrigerator, moving down the driveway on a platter, and sizzling over the fire set the stage for a barbecue.

All of us are familiar with the "conversational titles," and they often work better than the conventional printed ones. "We'd like to show you a picture of the family

enjoying a barbecue." That covers the story we have outlined better than a dozen eye-jarring interjections, no matter how tricky or professional you make them. If you wish to insert titles, however, mark the places on your film with pieces of string or tape and splice them in.

The next step is to show your sequence. Check over your projector to be sure it will be presented with the maximum effect. Only good, clean lamps should be used, for blackened ones will cause loss of brilliance on the screen. Go over both surfaces of the projection lens and the reflectors with a clean, soft cloth, removing any smudges that may have collected. Wipe oil and bits of emulsion from the film track to keep them from scratching or clouding the film. If the projector is equipped with a rheostat, set the lever for minimum illumination and let the machine warm up.

You will, of course, not forget to thread the film in the track with loops of the size called for in the manual, otherwise strain on the film will cause it to wear. Follow the manufacturer's recommendations also when it comes to brilliance of screen illumination, for too little light will cause underexposure and too much will wash out the images.

It is important to have a good screen. A large sheet of dull white paper, or even a large white blotter, will serve; but whatever screen you use should not permit light to leak through, for all that passes in this manner is lost to the audience, and extra power in your lamp will result only in that much variance from correct exposure.

Care of the camera lens is the first step in care of film. Wipe dust, moisture, and fingerprints from the lens so the film will be clear. If the lens is removable, clean the gate at intervals, as at right

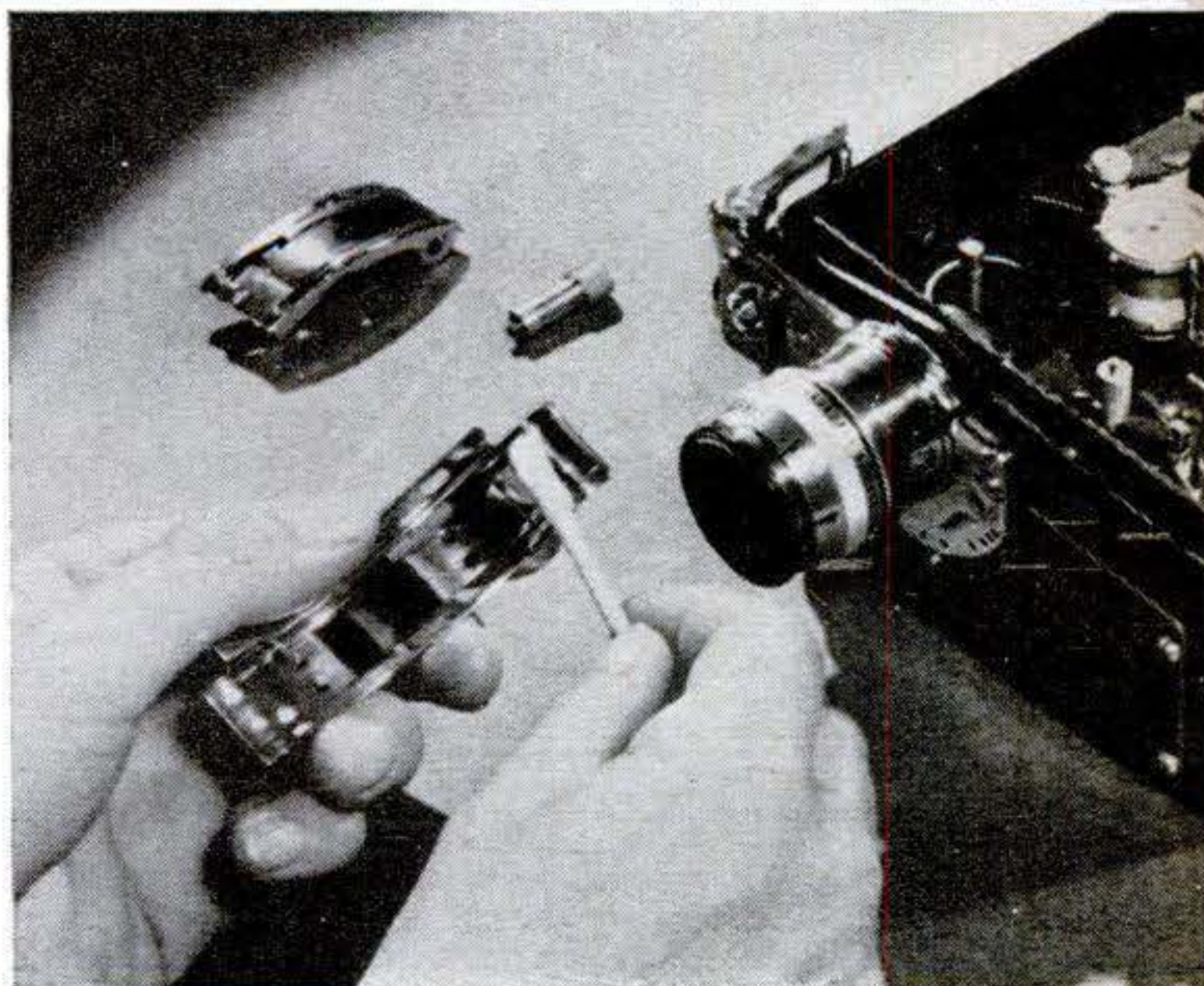
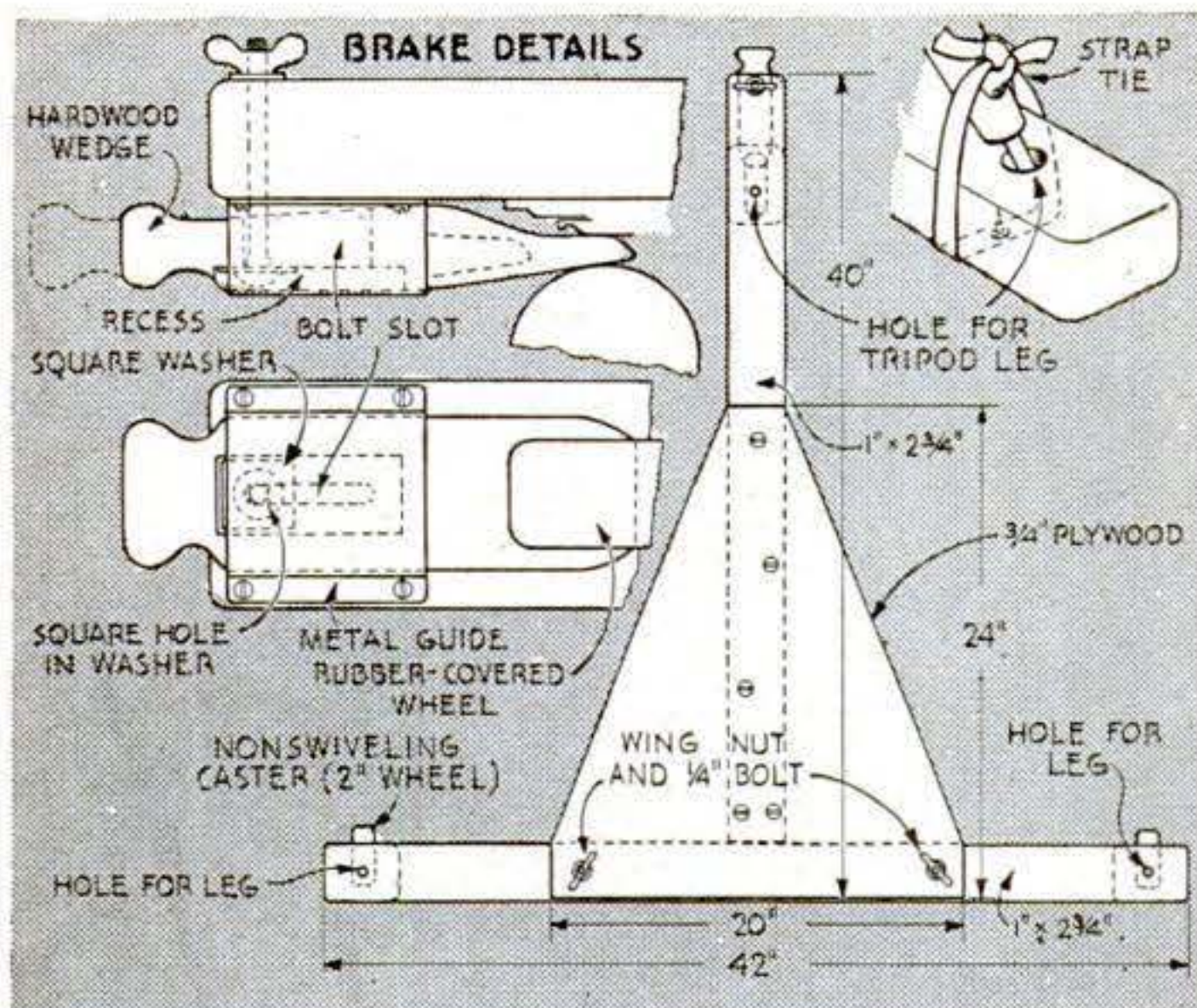
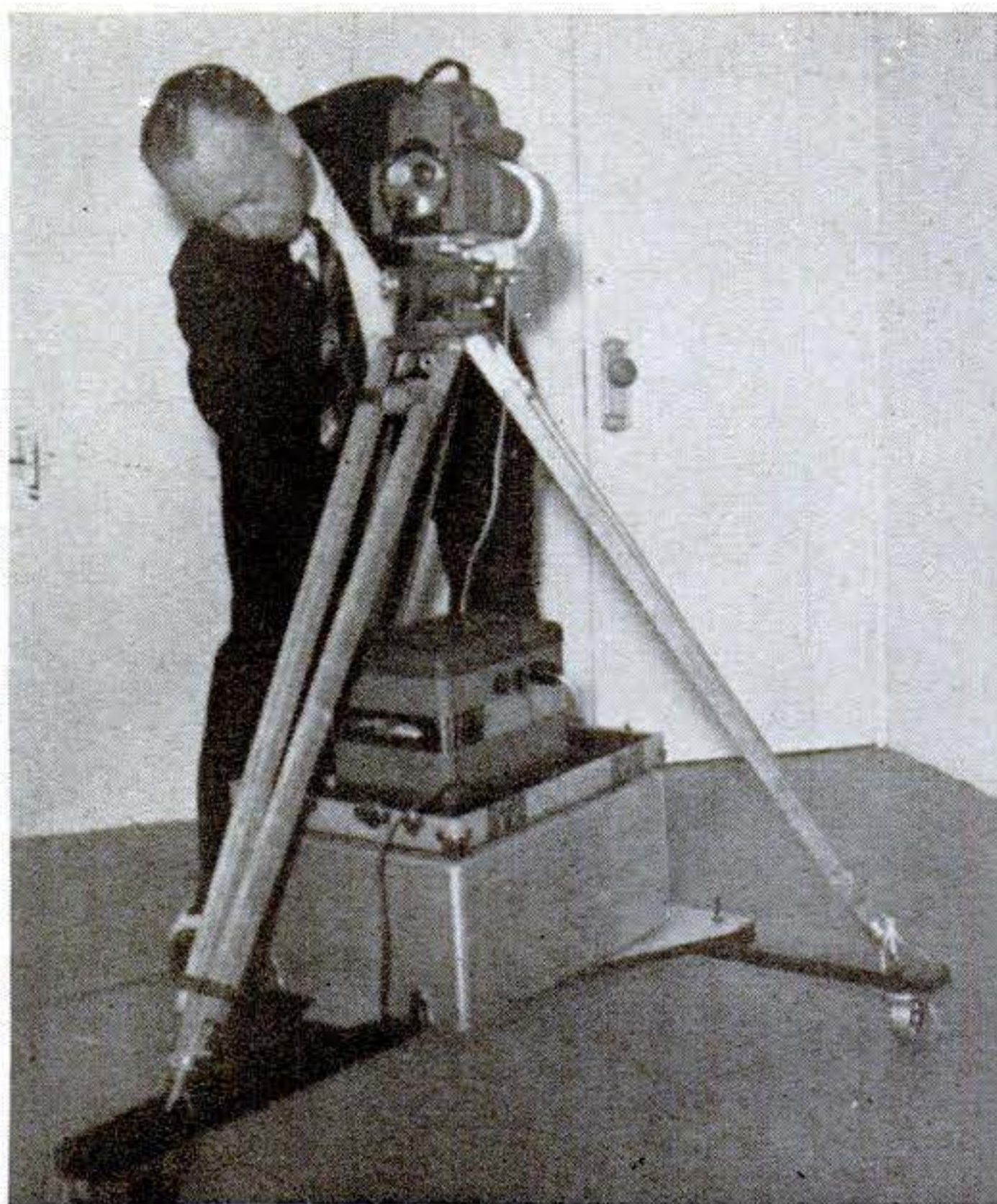


PHOTO IDEAS

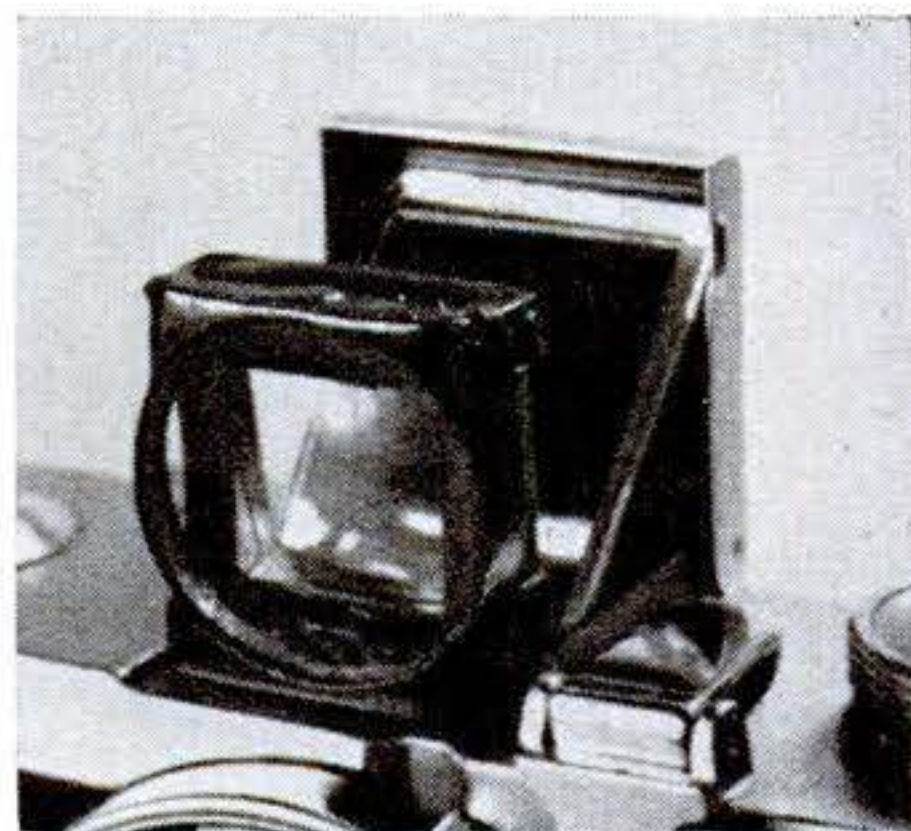


A TRIPOD TRUCK which is equipped with a brake to keep it from rolling at inopportune moments is a real aid to amateur movie makers. The truck shown at the right can be made with little difficulty, and it will afford the photographer full freedom in locating the camera just where he wants it. Once in place, the truck can be locked securely by a wedge brake on one caster. The tripod legs rest in holes near the ends of the T-shaped frame. Nonswiveling casters with 2" wheels



are fitted to the cross piece, while a swivel caster is attached beneath the front of the truck. Strap ties hold the tripod legs firmly in their sockets.—CLARENCE N. ALDRICH.

WAIST-LEVEL FINDERS are particularly useful in candid photography and in making angle shots. If your camera has only an eye-level finder, it can easily be converted for double duty. Cut from a small mirror a rectangular section which will fit at a 45-deg. angle between the front and rear elements of the finder. Although the image at waist level will be inverted, it will not be transposed, and hence there is no difficulty in following moving objects. Since the field is narrowed by the greater distance between eye and finder, correct this by putting a negative (reducing) lens, of about 70-mm. focal length, in front of the finder. Photo tape around this lens serves as a detachable fitting.—ROBERT SCOTT.



HEAVY BOOK ENDS are handy bases on which to attach spring-clamp reflectors for table-top pictures. Being easily moved, they allow the photographer more scope in arranging the desired lighting than do the chair backs or other objects on which such lamps are usually clamped. Place the lamp so that its center of gravity is on the same side as the foot of the book end.—WILLIAM SWALLOW.

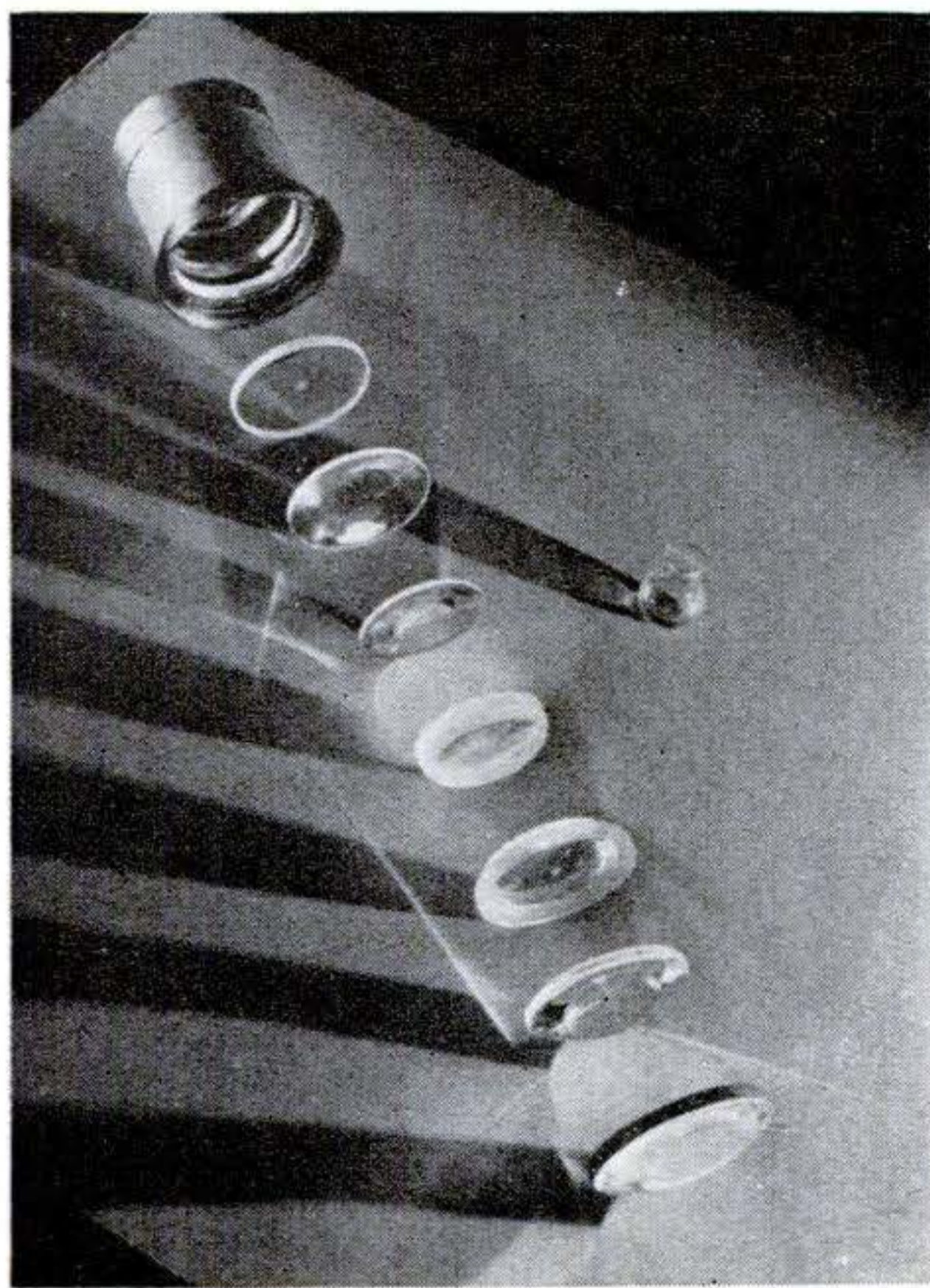
THE LIFE OF PHOTOFLOODS can be increased by using them *only* during actual shooting, and not while placing and aiming the lights and focusing the camera. If you do not have a dim-bright switch, use ordinary light bulbs in your reflectors while making these preparations. Put 50-watt bulbs where you will use No. 1 photofloods, and 100-watt bulbs in place of No. 2 photofloods. Substitute the photofloods when ready to shoot.—DONALD A. SIGMAN.

TESTING AN EXPOSURE METER suspected of inaccuracy may be done without a standardized photocell. Guided by the sheet of instructions packed with film, duplicate the exposure conditions called for, and then see if your meter indicates the same settings. For example, suppose a certain film specifies

f/6.3 and 1/25 second with two No. 1 photo-floods 6' from the subject. If your meter calls for a substantially different exposure, it is probably in error. The upper end of the scale may be tested outdoors in bright sunlight, but avoid doubtful conditions such as "hazy sun" or "light clouds."—J. W. C.

FOR CAMERA USERS

SHORTAGES of new photographic equipment for civilians are best explained by scenes such as that on the right, showing a combat photographer during the battle for Rendova in the Solomons. Here a 16-mm. magazine-loading movie camera takes telephoto shots of jungle tactics instead of filming some amateur's vacation.



LENS CEMENT, needed to hold together the components of highly corrected lenses, must possess both transparency and resistance to discoloration. Shown above are the seven components of an aerial camera lens, plus a small bottle of a new cement now used in Army Air Forces lenses. It was developed after combat experience—which may involve 150-deg. temperature changes in a few minutes—showed that previous adhesives might break up. This cement withstands desert-to-stratosphere contrasts.



AN IMMERSION HEATER, shown below, is needed by military cameramen at arctic bases to keep solutions usable in 50-below weather. The differing conditions which service photographic equipment must undergo are indicated by this and by the picture above.



AMPLIFIERS... Magic

HOW CIRCUITS ARE DESIGNED TO RESPOND TO FREQUENCIES RANGING FROM A FEW TO MILLIONS OF CYCLES PER SECOND

IN THE days when loudspeakers resembled Grandpa's ear trumpet, audio-frequency amplifiers, proudly wired with right-angled bus bars, were built around what looked like miniature power-line transformers. Today, amplifiers are almost all resistance-coupled. What happened to the transformers?

Theoretically, transformer coupling has many advantages over resistance-capacitance coupling. But theory involves the use of an ideal transformer—without core losses, winding losses, or resonance peaks—which remains nonexistent because there is no such thing as a pure inductance.

Because the magnetic field surrounding each turn of wire in a coil sets up a counter E.M.F. in adjacent turns, an impressed A.C. voltage results in a voltage difference between any two turns as well as across the entire winding. At extremely high radio frequencies, this may amount to hundreds

of volts. But two adjacent conductors at different potentials constitute a condenser, so our inductance coil is also a capacitance. The wire winding, like other conductors, also has a certain resistance.

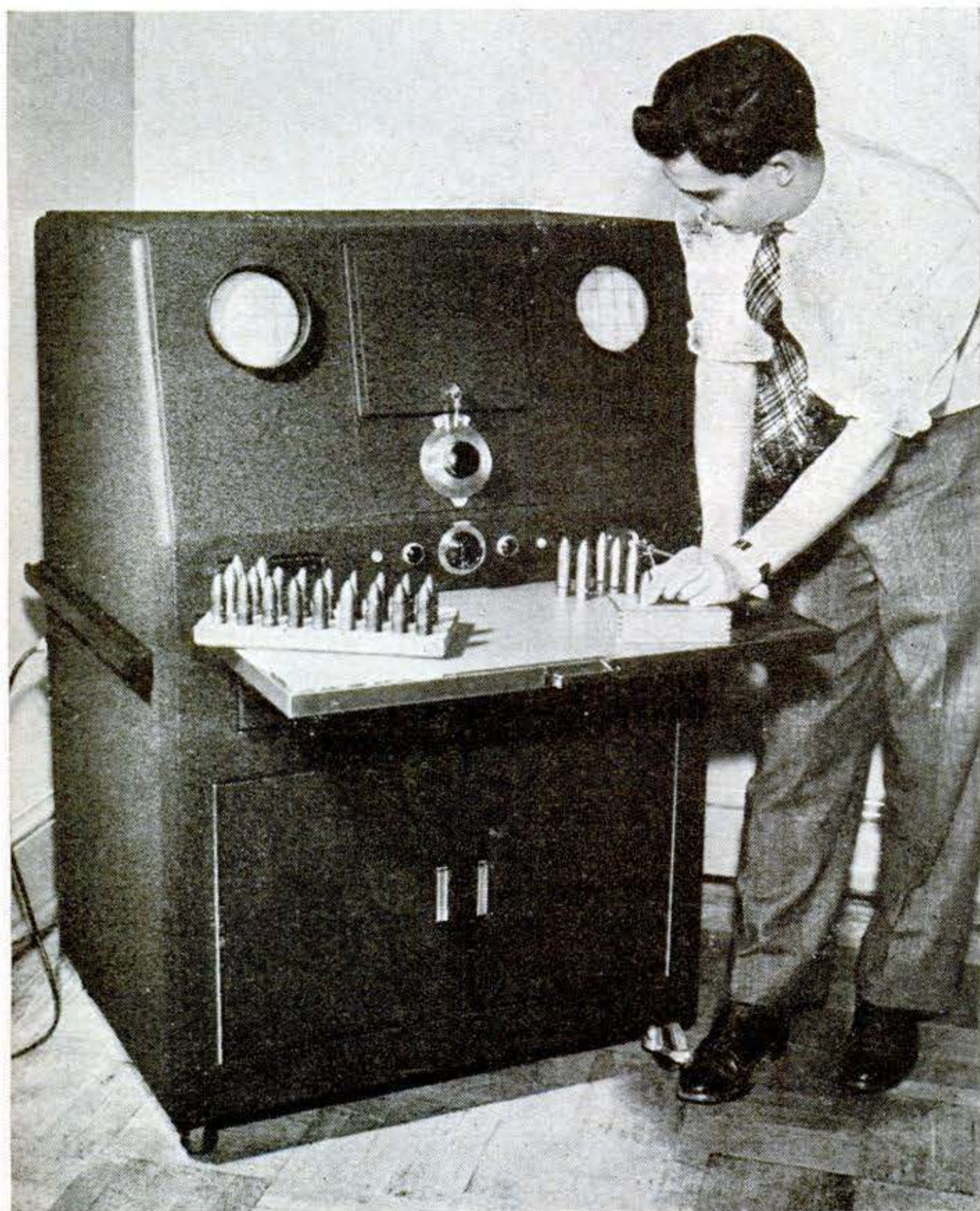
In electronics, these factors weigh heavily and were largely responsible for the abandonment of transformer coupling, for in audio-frequency transformers, the inevitable capacitance effects act with the inductance of the windings to produce resonance peaks within or near the audio-frequency range of between 15 and 15,000 cycles per second. By careful design, these resonance peaks can be shifted out of this range, but the linear-response transformers so built are high-priced precision instruments.

Another reason for discarding transformers is more complex. The maximum gain is obtained from a given tube when the load resistance is about the same as the plate resistance of the tube. Modern pentodes have a plate resistance of several hundred thousand to a million ohms or more. While it is impractical to make a million-ohm transformer winding, a million-ohm resistance is easy to make and correspondingly cheap.

Another advantage is that a complete resistance-capacitance coupling takes less space than even the mounting bracket for a transformer. Furthermore, resistors and condensers are unaffected by near-by power transformers, which may cause hums in audio coupling transformers.

For all these reasons the iron-core transformer is limited to push-pull driver circuits and the output

Metals are checked, evaluated, and even sorted by the Du Mont Cyclograph. Instruments like this usually employ broad-band-pass amplifiers which, if used in a radio, would amplify all frequencies at the same time



POPULAR SCIENCE

Levers of Electronics

By

JOHN W. CAMPBELL, JR.

circuit of resistance-coupled amplifiers. Radio-frequency amplifiers, however, make good use of another kind of transformer—the air-core type—by taking advantage of its tendency to tune to certain resonance frequencies. Figure 1 shows a standard radio-frequency circuit. A single such unit may feed a superheterodyne circuit, or three may be combined into a tuned-radio-frequency (T.R.F.) set.

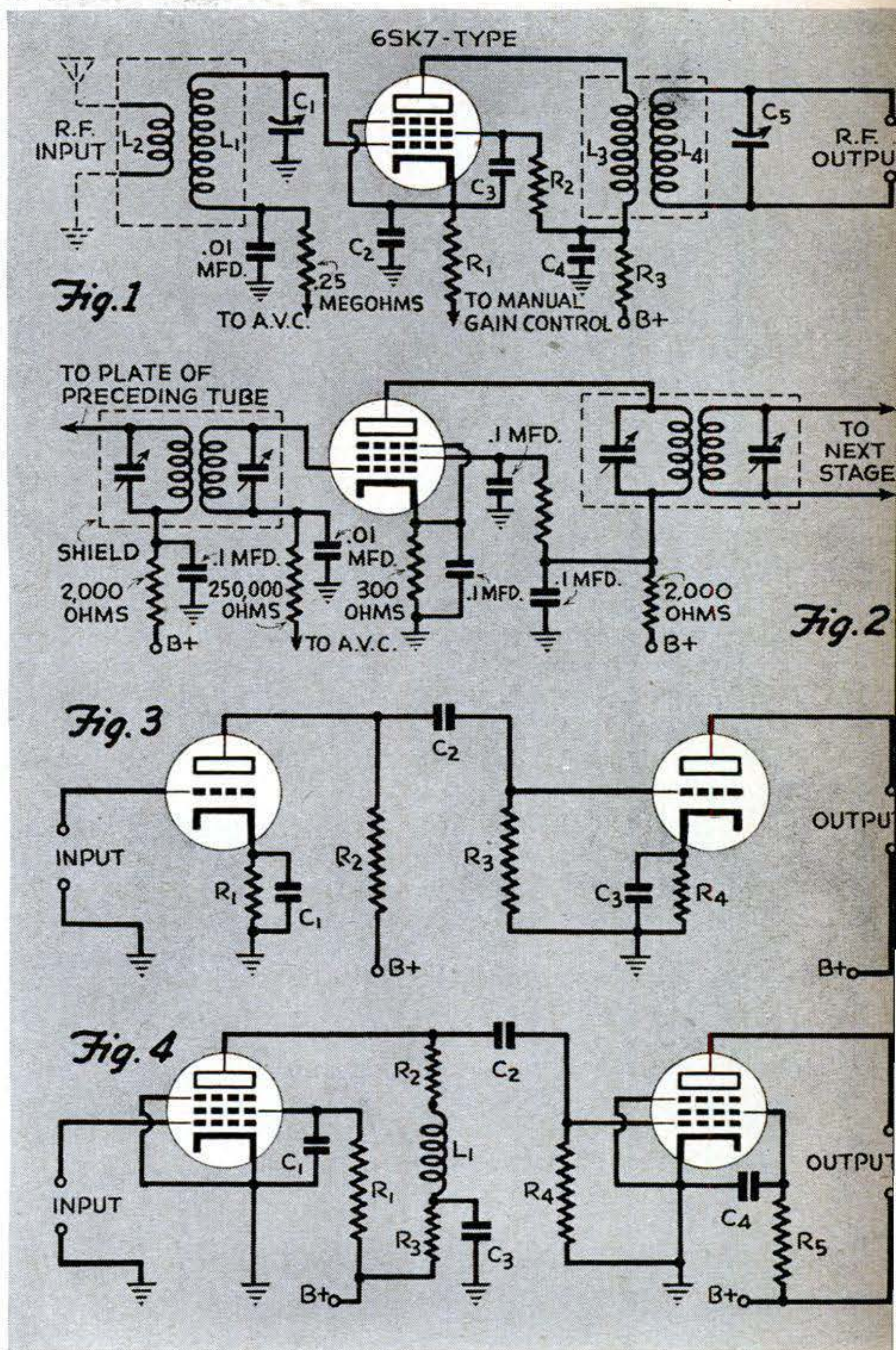
Only the secondaries of the transformers are tuned. The adjustable condensers are usually both on the same shaft, or ganged. They are shown in the diagram by a symbol with a curved arrow representing the movable plates.

Transformers with both a tuned primary and secondary are more selective and give greater gain. Figure 2 shows how they are used in a superheterodyne hookup. An incoming signal is first converted to a predetermined intermediate-frequency (I.F.) signal, and the I.F. transformers are tuned once to this frequency when the set is assembled. The tuning condensers (trimming condensers) are represented by the conventional condenser symbol with an arrow through it. In practice, they are usually built into the metal housing or shield surrounding the transformer, with only the heads of the adjusting screws accessible, and are tuned with a screwdriver. If left unshielded, such transformers would pick up hum from a power transformer, or one coil could affect another.

The response range of transformer-coupled amplifiers is thus governed by resonance effects due to inductance and capacitance, and it is these that enable us to tune R.F. circuits so that they will respond only to the frequency of the signal desired. With A.F. amplifiers, the problem is just the opposite. Voice and music frequencies

range from 15 to 10,000 cycles. If an audio-frequency amplifier responded only to frequencies of 200 to 2,000 cycles, both low and high notes would be lost. Then what governs the response range of a standard resistance-coupled circuit such as that shown in Fig. 3?

Since D.C. will not pass through the coupling condenser C2, it is plain that the circuit will not amplify D.C. By definition, one cycle per second is A.C., but the circuit will not pass that either. There is a lower limit to the frequency C2 will pass, and this depends upon its value and that of the



resistor R3. If R3 drains the charge off C2 as fast as, or faster than, it accumulates, no signal will pass to the grid of the second tube. For frequencies down to 100 cycles, with a 500,000-ohm value for R3, C2 may be .01 mfd. For a high-fidelity amplifier sensitive to frequencies as low as 15 cycles, C2 would have to be of .1-mfd. capacity or more.

Response to high frequencies is limited by another factor—losses from wiring and tube capacitance. The tube sockets, resistances, and condensers are mounted on a metal chassis. But any two conductors separated by insulation constitute a condenser. Thus there is capacitance between the wiring of the amplifier and the chassis. Since this is only about 30 mmfd., it is negligible at low frequencies. But a condenser offers less resistance to A.C. as the frequency of the current increases. At 1,000,000 cycles, capacitance losses can be appreciable.

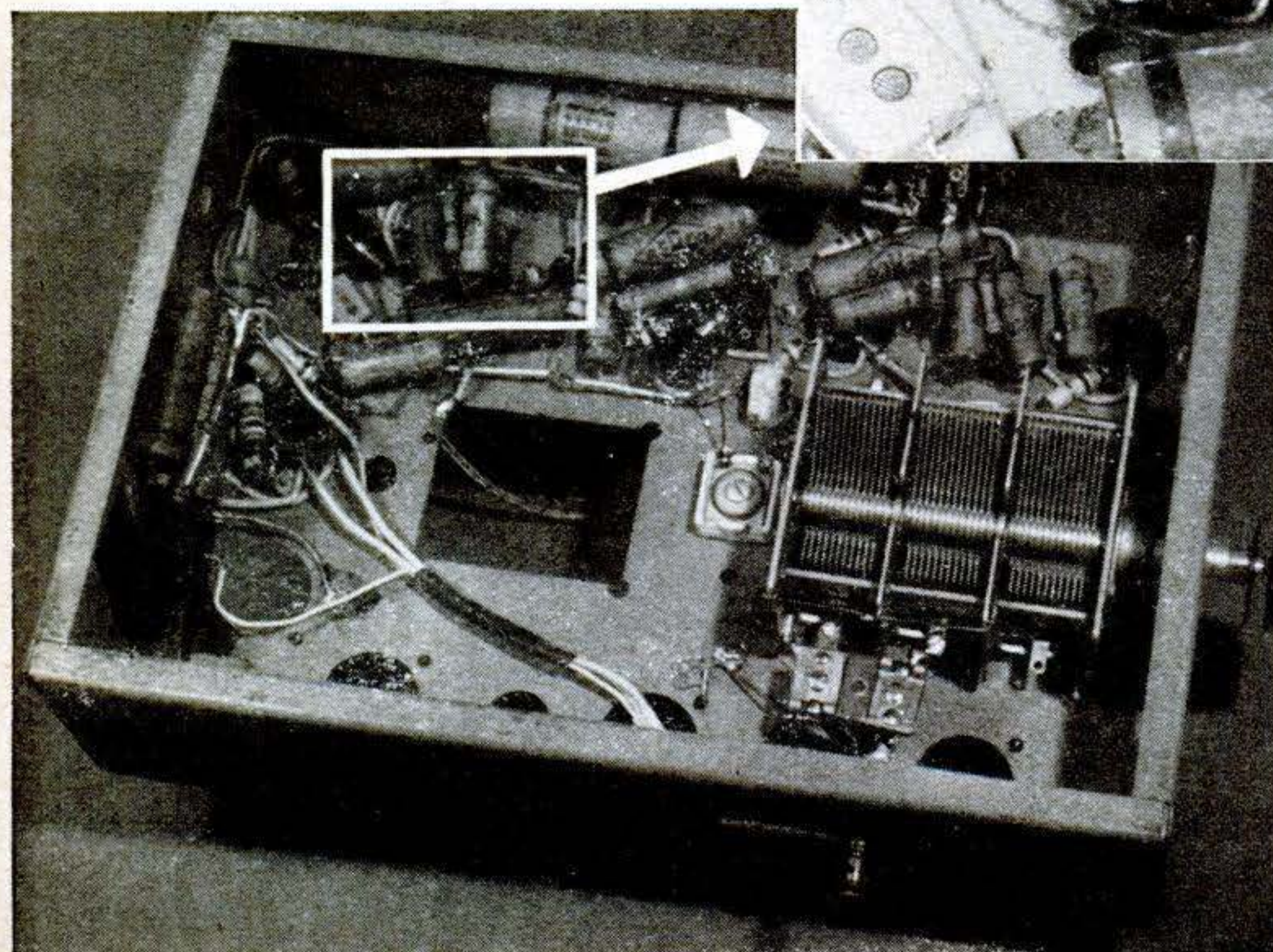
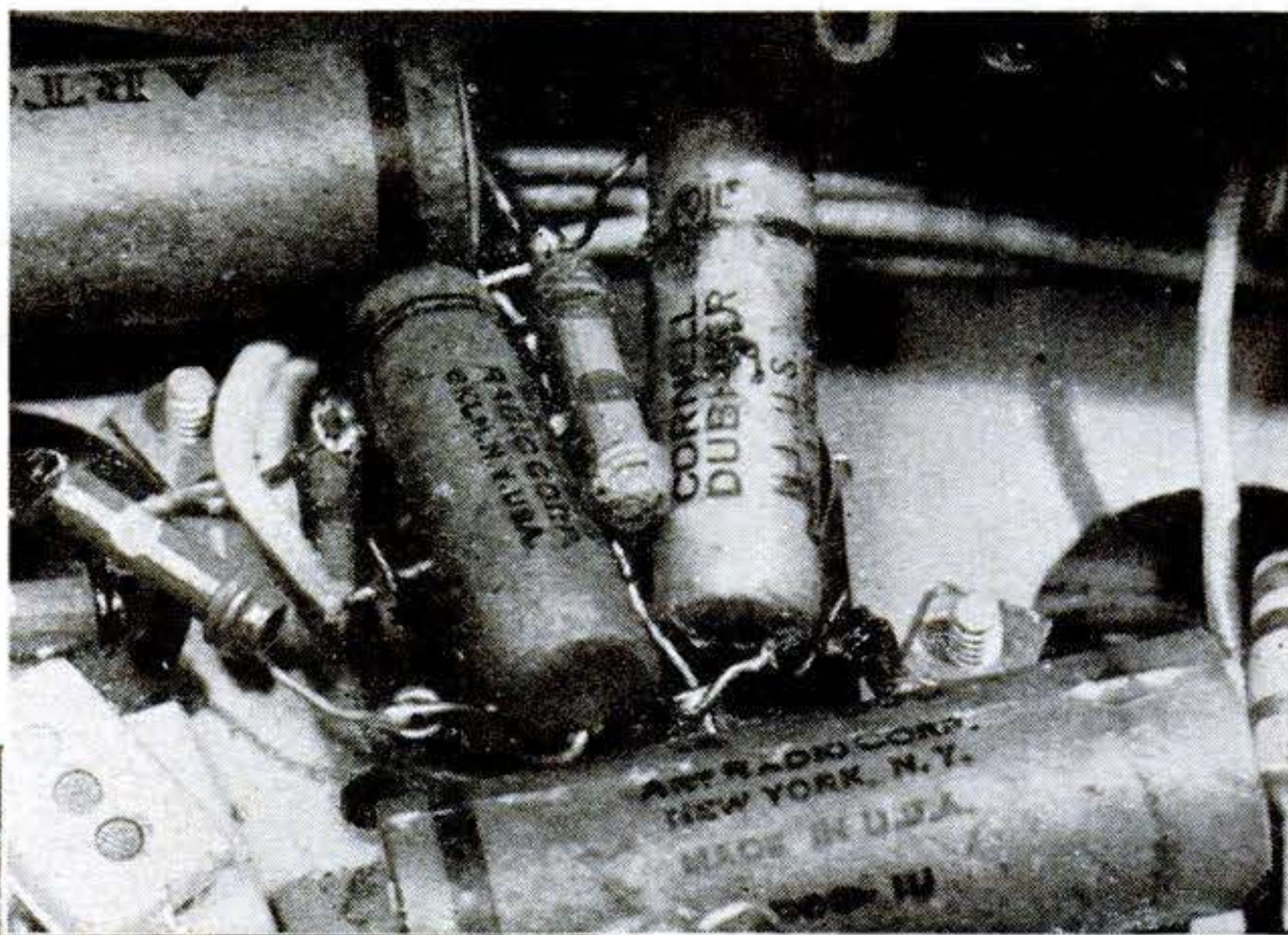
In radios this effect is nullified by using this wiring capacitance as part of the tuning capacitance of the tuned-transformer coupling. One side of each secondary and tuning condenser is grounded to the chassis. The trick can't be used with a television video (picture-image) amplifier, which must faithfully amplify all frequencies from 30 to 4,000,000 cycles. This problem is solved by the hookup shown in Fig. 4.

The load resistance, instead of being a resistor, consists of a resistor and an inductance in series. To A.C., such a combination offers ordinary resistance plus inductive reactance, the sum of these being termed impedance. A resistor of low value is used for R2, greatly impairing the amplification at low frequencies, since, as was stated earlier, maximum gain is obtained when load impedance is equal to plate impedance.

The inductance L1, however, will offer more and more resistance as the frequency increases, and at very high frequencies, the impedance will be great enough to outweigh the resistance of R2 and thus greatly increase the amplification gain.

Because at medium or low frequencies the load impedance is too low to match that of the tube, the gain is held down to the same level as that obtained at high frequencies after capacitance losses have taken their toll. Thus these losses, although they cannot be eliminated, can be compensated for. The coupling described provides just the proper adjustment automatically.

Resistance R3 and condenser C3 in this circuit are not merely the usual decoupling circuit; they help improve low-frequency response. At frequencies to which C2 offers little impedance, C3 similarly offers little or none. But at lower frequencies to which C2 offers series impedance, so does C3. While C3 passes the A.C. signals freely to the ground, resistor R3 is to all purposes not in the circuit. But when at low frequencies C3 offers appreciable impedance, R3 becomes effective, increasing the total load resistance and thus the gain. With rightly proportioned values of R2, R3, L1, C2, and C3, an amplifier could uniformly amplify all frequencies from 50 to 5,000,000 cycles.



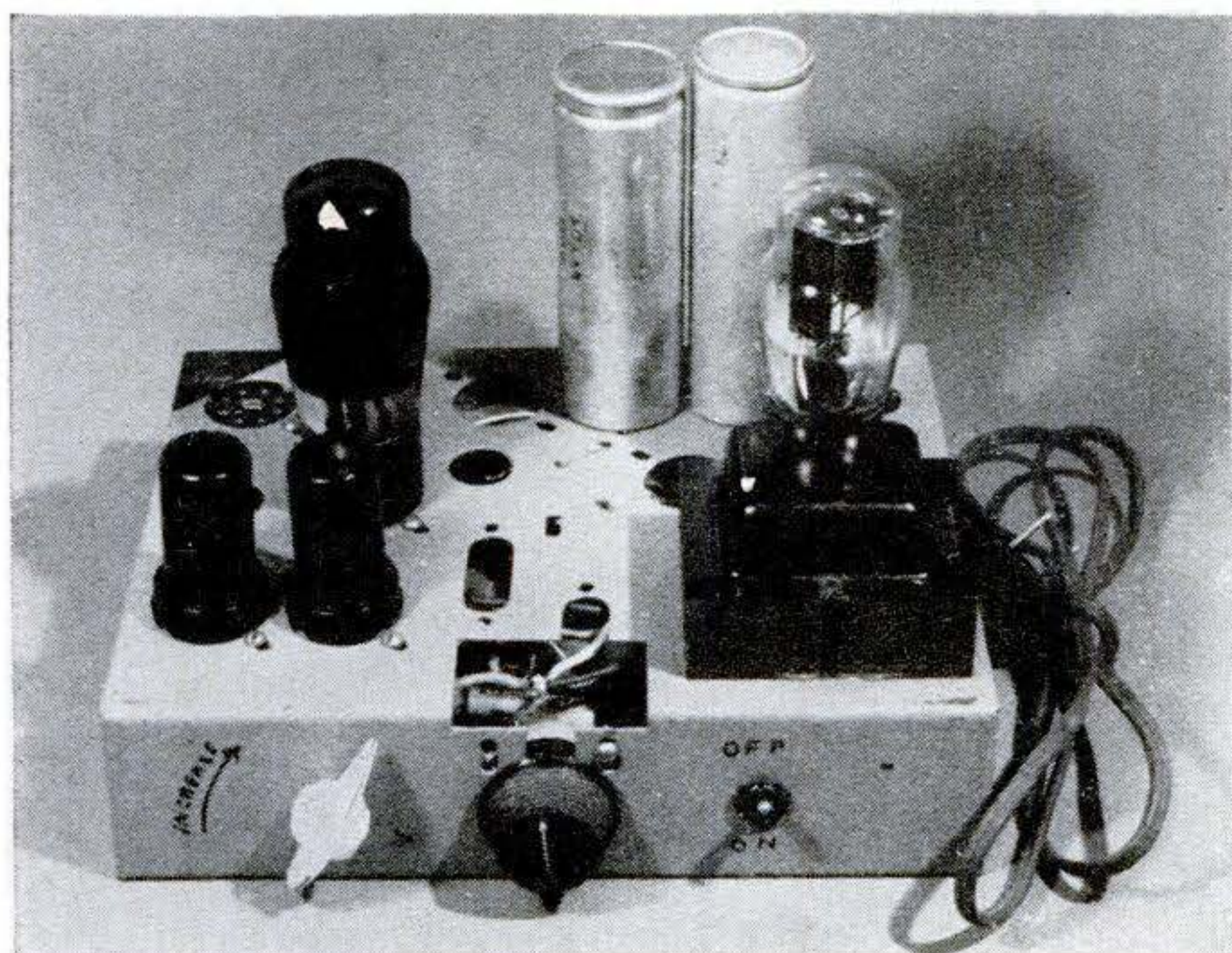
Wiring under the chassis of a receiver is a studied jumble. The close-up view above is that part shown within the square at left

The plate-load resistor is mounted on the tube socket and a decoupling resistor is attached there. Howl results if a plate lead passes too close to a grid lead of a preceding stage

POPULAR SCIENCE

HIGH-GAIN A. F. AMPLIFIER

Resistance-Coupled Hookup with Two Pentodes Gives Big Volume



If a power pack is built in, as above, keep it as far from the amplifier wiring as possible. A type-80 rectifier was used here

pulse in the coil. This, amplified many thousand times, actuates the loudspeaker.

The amplifier is hard to build in proportion to its great sensitivity, and all the precautions suggested in a previous article must be carefully observed. Shielded input leads consisting of a wire enclosed in a braided metal sheath are a "must." The sheath is grounded and serves as one lead, eliminating stray-current pickup. Use an old radio chassis or a tin cigar box enameled black; the chassis must be metal.

Values of the various parts are shown for the 6SJ7 and 6V6, but use whatever tubes you have. Tetrodes will serve in place of the pentodes. Consult the tables of amplifier values in standard tube manuals for data

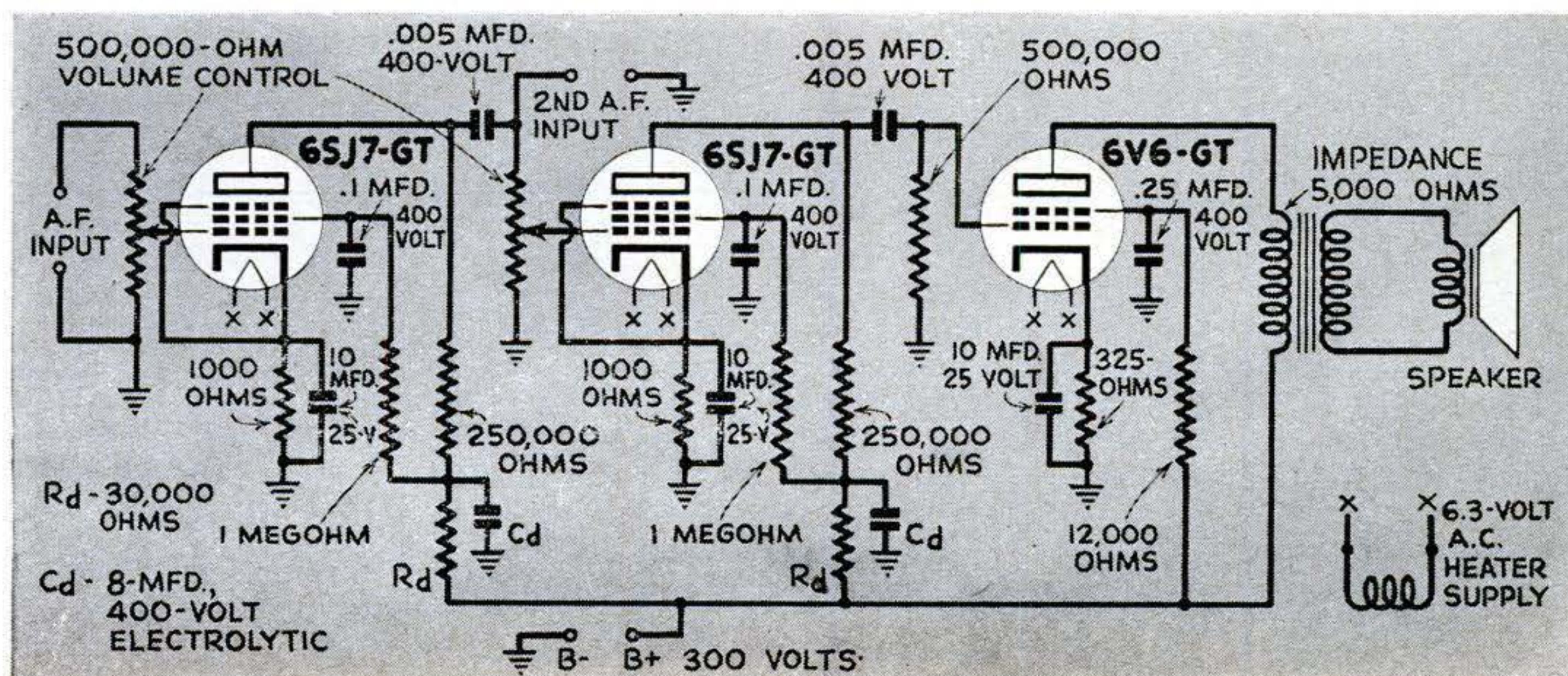
SO MUCH gain can be had from this two-pentode hookup that for ordinary purposes the full output will rarely be needed. The amplifier will step up the output of a crystal-detector receiver to full loudspeaker volume. A phonograph pickup or vacuum-tube detector should be connected at the second A.F. input terminals.

As a trick demonstration of electronics, you can even make audible the movement of molecules in an iron bar that is being magnetized. Hook the primary of an old audio transformer or a choke coil across the input terminals and place a big nail or a bolt within the coil. If a small permanent magnet is now brought near the nail, a rushing sound will be heard from the speaker. As the molecules in the bar are pulled into alignment by the magnet, each in flopping over generates an electrical im-

applicable to your tubes. In doing so, remember that the second volume control constitutes part of the circuit of the first tube, not of the second. The setting of this control determines what part of the output of the first stage is fed to the second grid.

If 60-cycle hum is present, connect two 50-ohm resistors in series across the heater wires, and their midpoint connection to a 12-volt tap on a 200,000-ohm voltage divider hooked across the high-voltage plate supply. This will give the heaters a positive potential with respect to the cathodes, eliminating electron emission from the heaters to the cathodes, a phenomenon that is sometimes the cause of persistent hum.

It is essential to keep all heater wires as far from the grid leads as possible. Twist them tightly and lay them along a corner of the chassis.



WHAT TO DO ABOUT INTERMITTENT RECEPTION

"Servicing Your Radio"

RADIO servicemen and home mechanics are often hard put to find the cause of intermittent or fading radio reception. A receiver working perfectly one minute may drop in volume or fade away completely the next, perplexing the repair man no less than it exasperates listeners. Banging the cabinet, flicking the switch, or simply walking heavily across the room will often jar the radio back to life, but this is only a temporary expedient, and the reception is sure to fade again later on. In the following instances several of the more common manifestations of such trouble were traced to their source, and lasting remedies were applied.

A small A.C.-D.C. five-tube superheterodyne was afflicted with abrupt increases and decreases in volume. The fluctuations usually occurred when house lights were turned on or off. It was found that the .05-mfd., 400-volt tubular condensers in the grid returns of the A.V.C. tubes (Fig. 1) were faulty. These had to be replaced.

Similar trouble was experienced by the owner of a set that could be stirred into renewed operation only by snapping the on-off switch or turning on a house light. After all tubes were checked, it was discovered that reception could be restored by touching the plate leads of the first detector or converter tube, or the IF leads or oscillator-tube leads. This led to the trouble being traced to a defective detector-cathode by-pass condenser (Fig. 2).

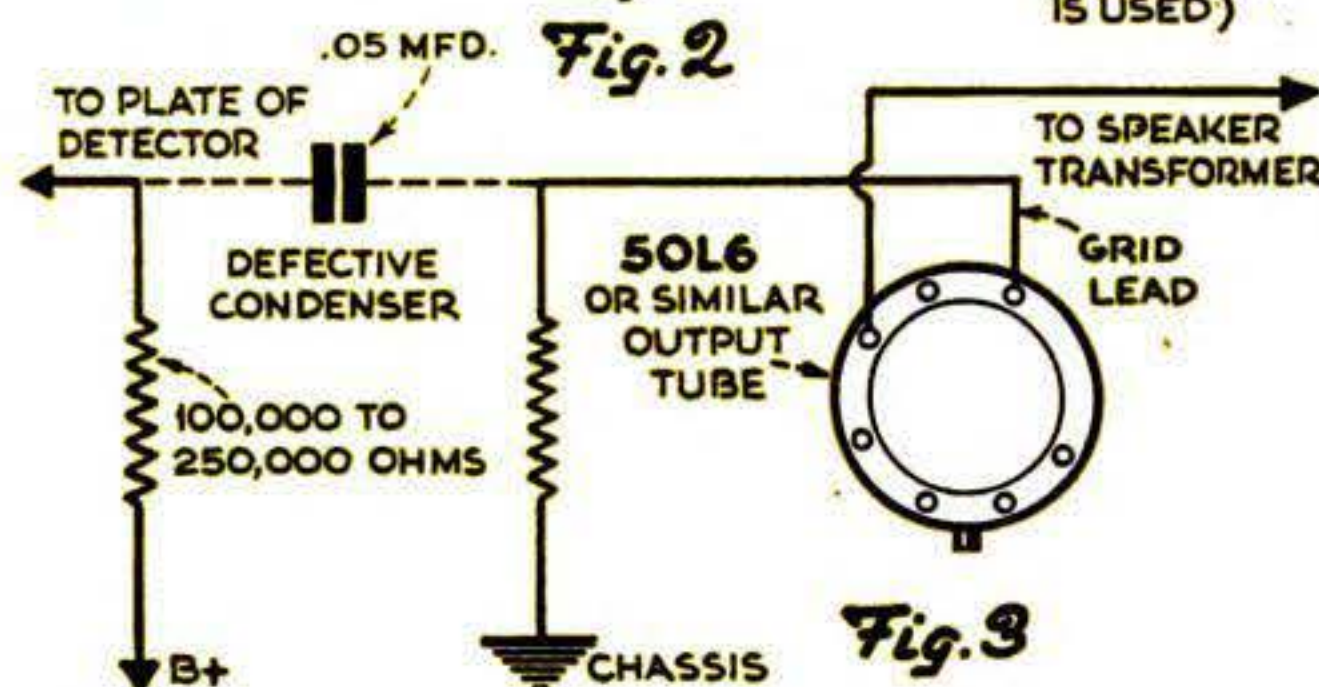
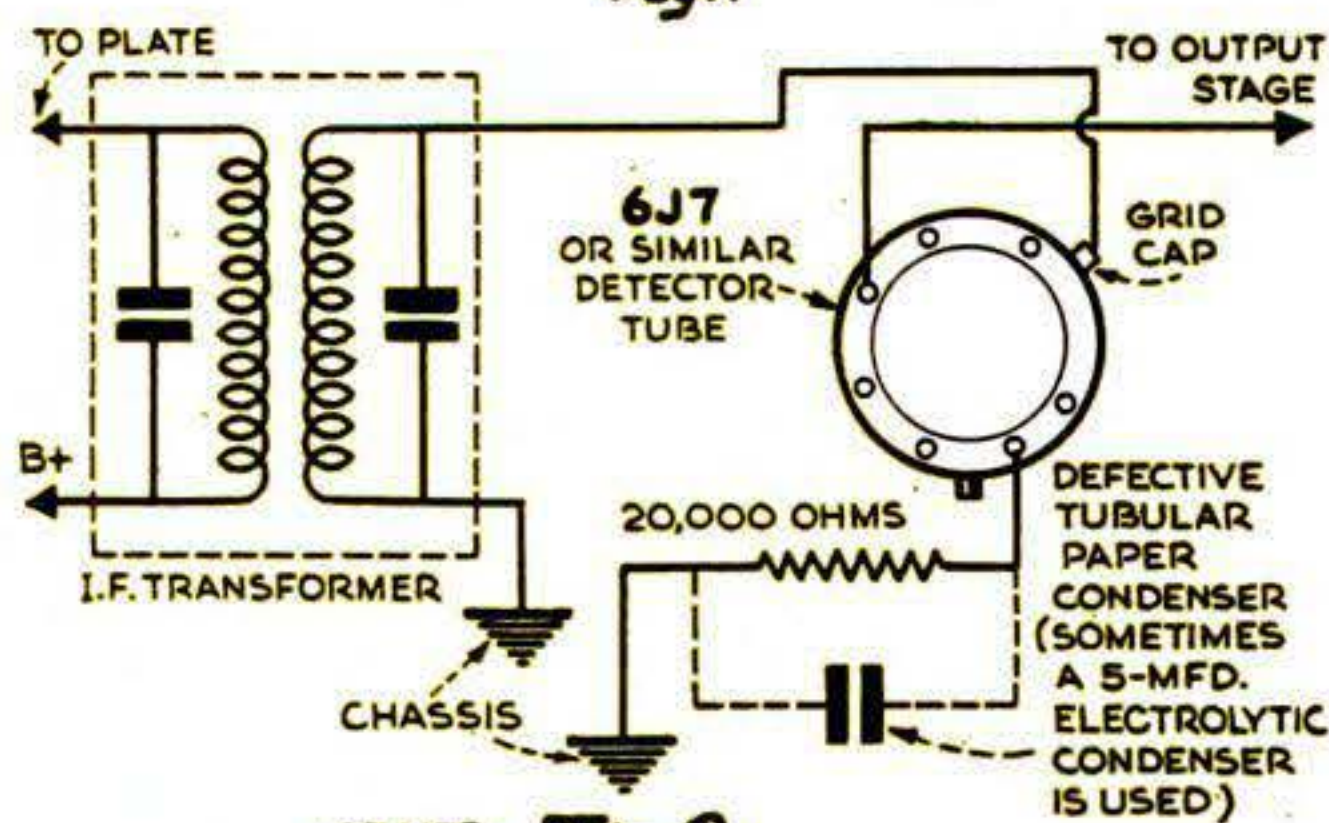
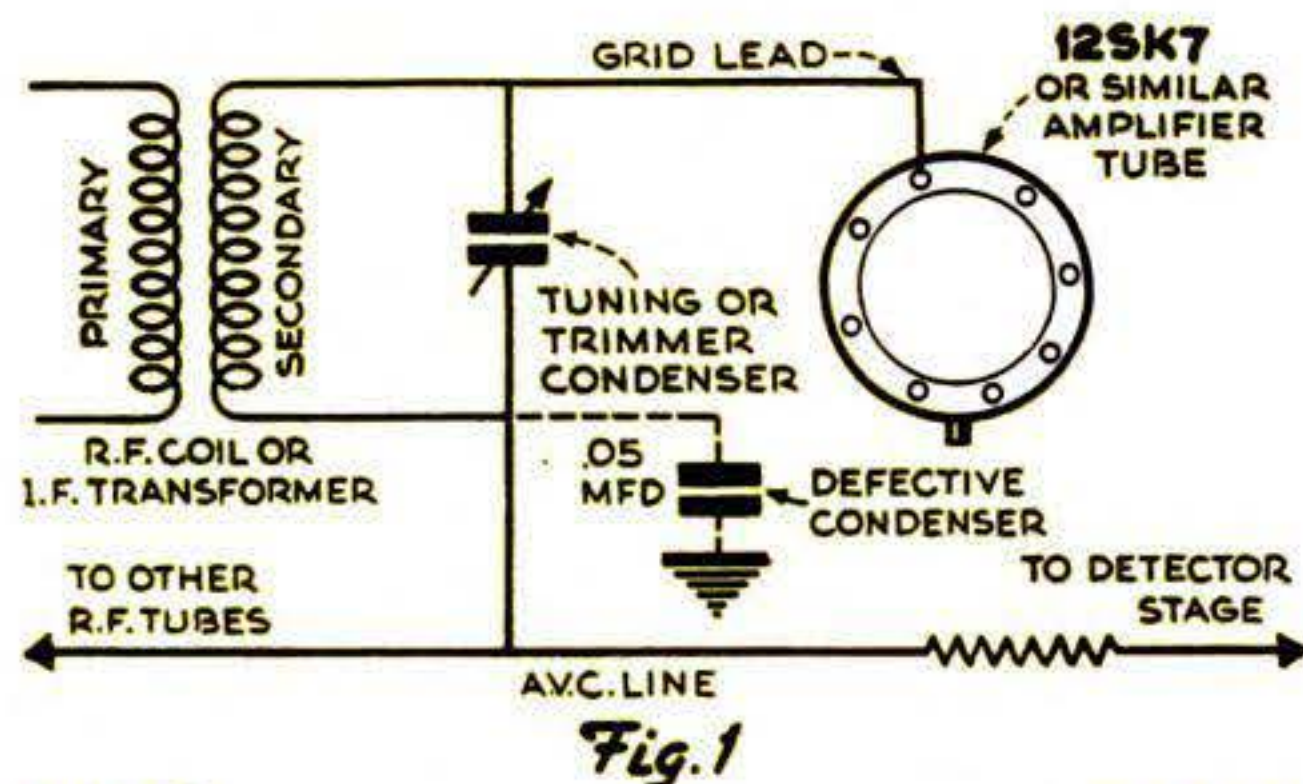
Frequently intermittent reception is due to a faulty coupling condenser in the grid circuit of a power-pentode tube (Fig. 3), such as a 50L6 or a 43. This causes a radio to lose volume suddenly. The fault can be corrected only by replacing the condenser, which usually has a value of .05 mfd., 400 volts.

Intermittent reception is also often caused by dirty wave-band switches. Hardened flux or grease may accumulate on the contact points, which can be easily cleaned with carbon tetrachloride and a small cloth or toothbrush, as shown in the photo. Even if a switch tests O.K. on 110 volts, it will still cause intermittence if the contacts are not clean.

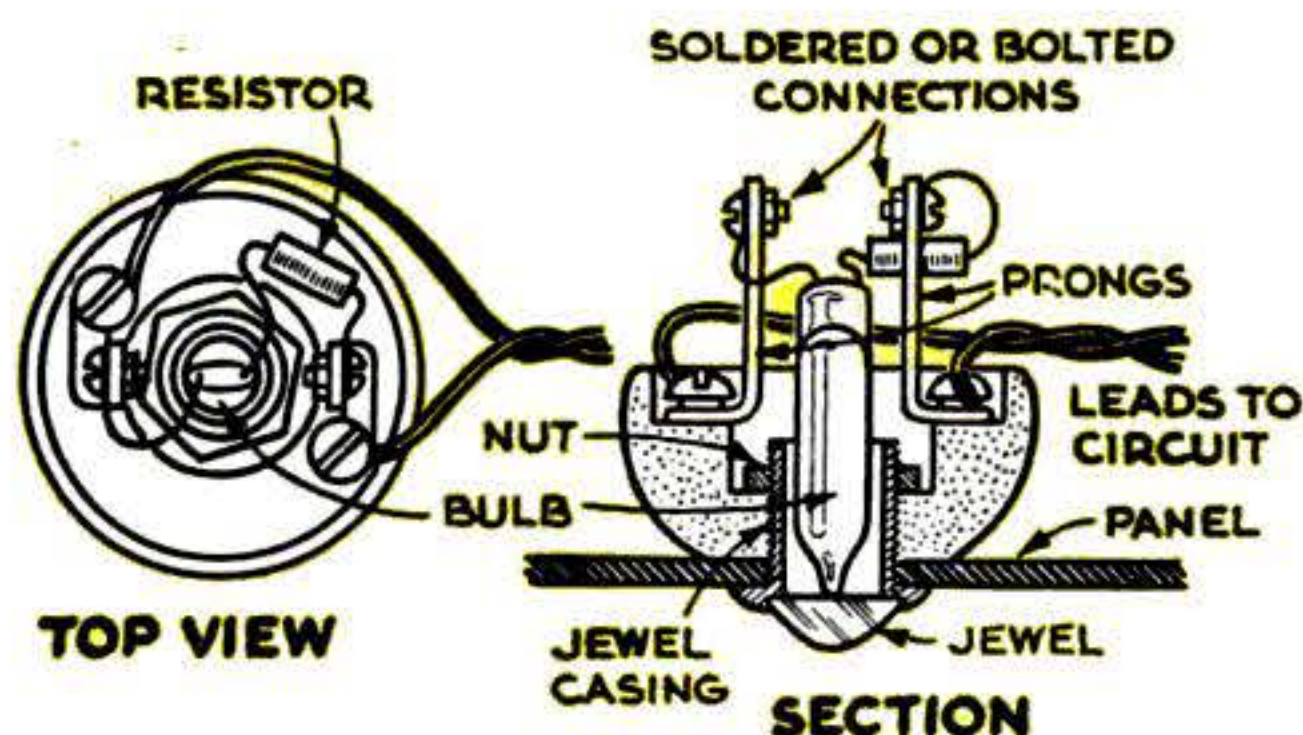
Radios with weak or noisy reception may owe their eccentricity to corrosion of R.F. or I.F. grid-return leads at the chassis. These points should be carefully inspected. Usually it is best to install a common ground wire and connect grid returns to it.



Dirty wave-band switches often cause intermittent reception. Clean them with carbon tetrachloride



radio ideas



MIDGET NEON BULBS of the baseless, resistor type make desirable pilot and indicator lights where high visibility is not required, since their small current consumption contributes to their long life. Ordinary appliance plugs can be used as panel mounts for these bulbs if the cord hole is reamed out to fit over the threaded casing of a pilot-light jewel so that the assembly can be secured on the panel, as illustrated above. The tip end of the bulb is inserted in the casing, and the leads from it and its resistor are connected to the ends of the plug prongs. Short leads and a drop of sealing wax hold the bulb in position. Binding screws on the plug are used to connect the device into the circuit.

A POWER PACK for furnishing plate current to a radio or amplifier, or for experimental purposes, can be built from four discarded 35Z5 rectifier tubes. These have a double filament, one side of which serves as a resistor for the pilot light, and this usually burns out first.

As shown in the diagram below, the unit is essentially a voltage doubler, and no transformer is needed. The filter block has two 8-mfd. condensers and one of 16-mfd. capacity across the output terminals. This should have a rating of at least 250 volts; one of 450 volts would provide a better safety factor. The field coil of a small dynamic loudspeaker with a resistance not exceeding 450 ohms may be used as a filter choke.

A voltage doubler such as this must never be used with grounded apparatus,

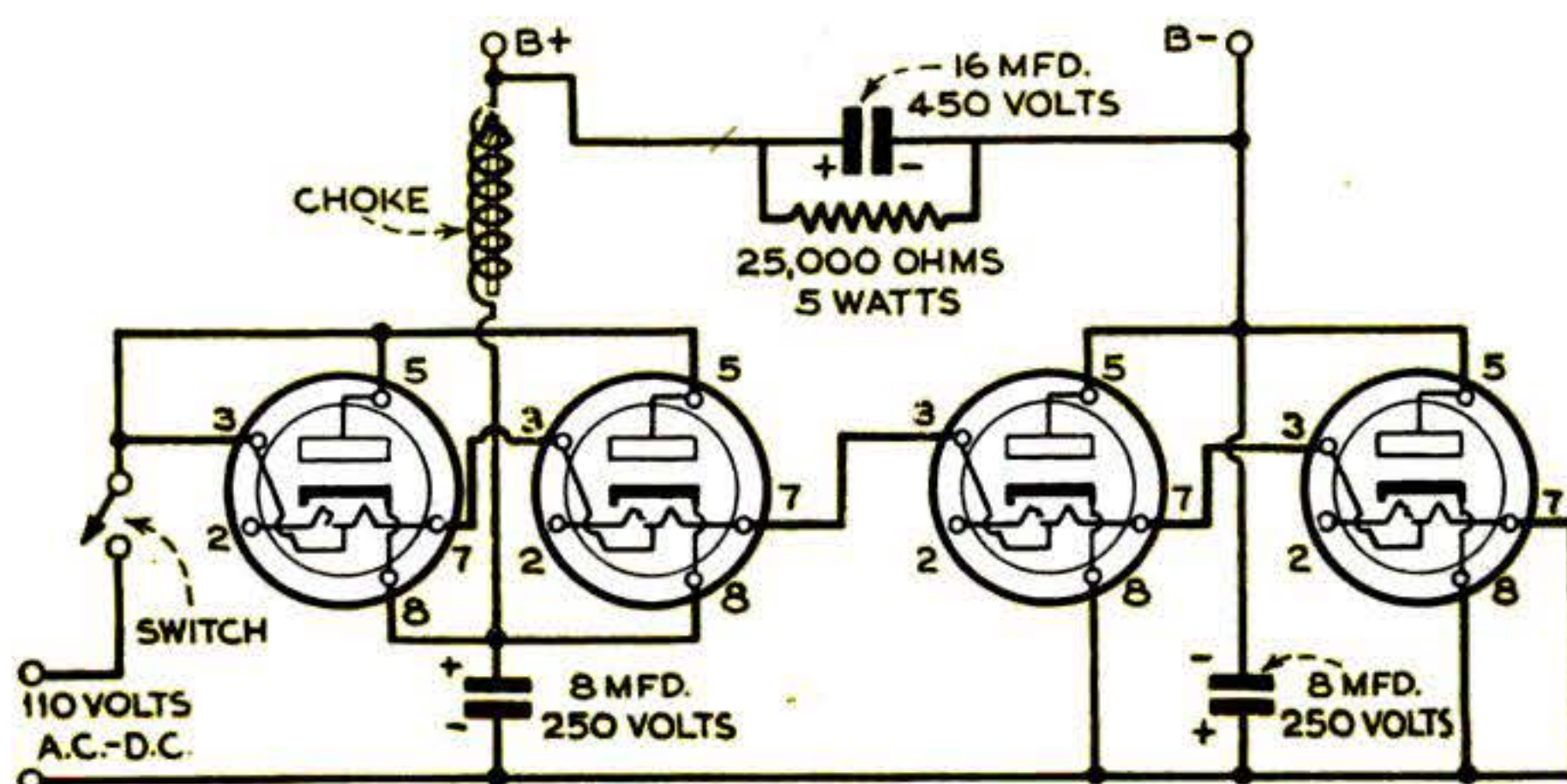
BROKEN DIAL CABLES can be replaced with a good quality of stout thread that has been given a simple toughening treatment. First soak the thread in alcohol and then, while it is still wet, draw it back and forth across a piece of rosin until the rosin has been thoroughly worked into every fiber. Greatly increasing the strength of the string and giving it surprising durability, the process also imparts tractive power sufficient to keep it from slipping on the pulleys of the ordinary set. The string should be allowed to dry thoroughly before installation.

SEALED RELAYS like that at the right will fit any standard octal socket, providing delays of one to 100 seconds when installed in transmitters as automatic cutoff or cutin devices. They are compensated for ambient changes of -40 to $+100$ deg. F. This type of relay is available as a single-pole device with either normally open or normally closed contacts. It is capable of handling up to 12-amp., 115-volt A.C. or D.C. The contacts are hermetically sealed in inert gas to prevent oxidation.



as for example a radio, unless the equipment is grounded through a 100,000-ohm resistor with a .1-mfd. paper condenser in parallel. Should touching the set cause a mild shock, try reversing the wall plug.

Two tubes instead of four would deliver enough current for small radios, but the two tube heaters cannot be connected across the 110-volt line without also using a suitable line-cord resistor.—WALTER ANDERSON, JR.



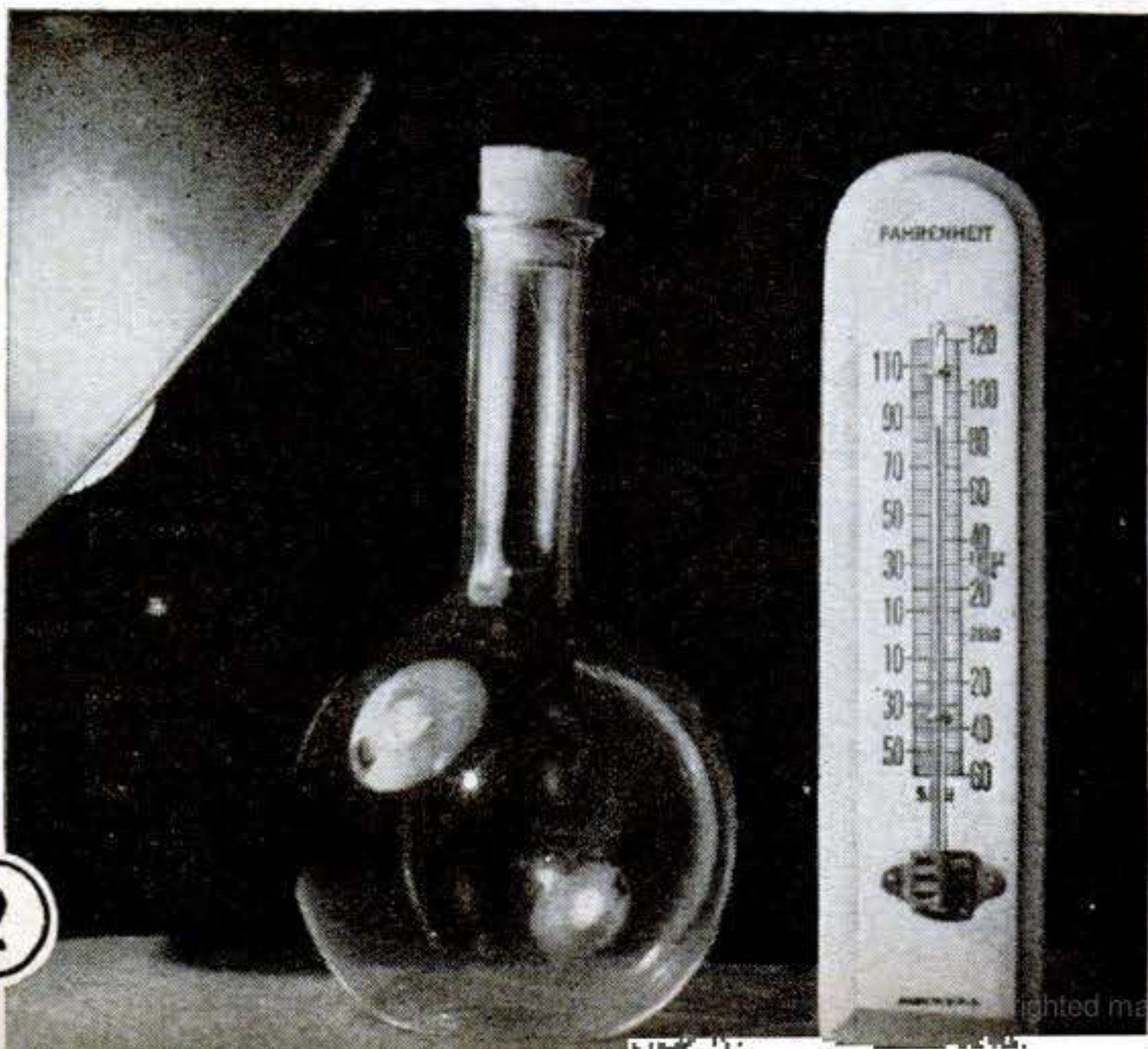
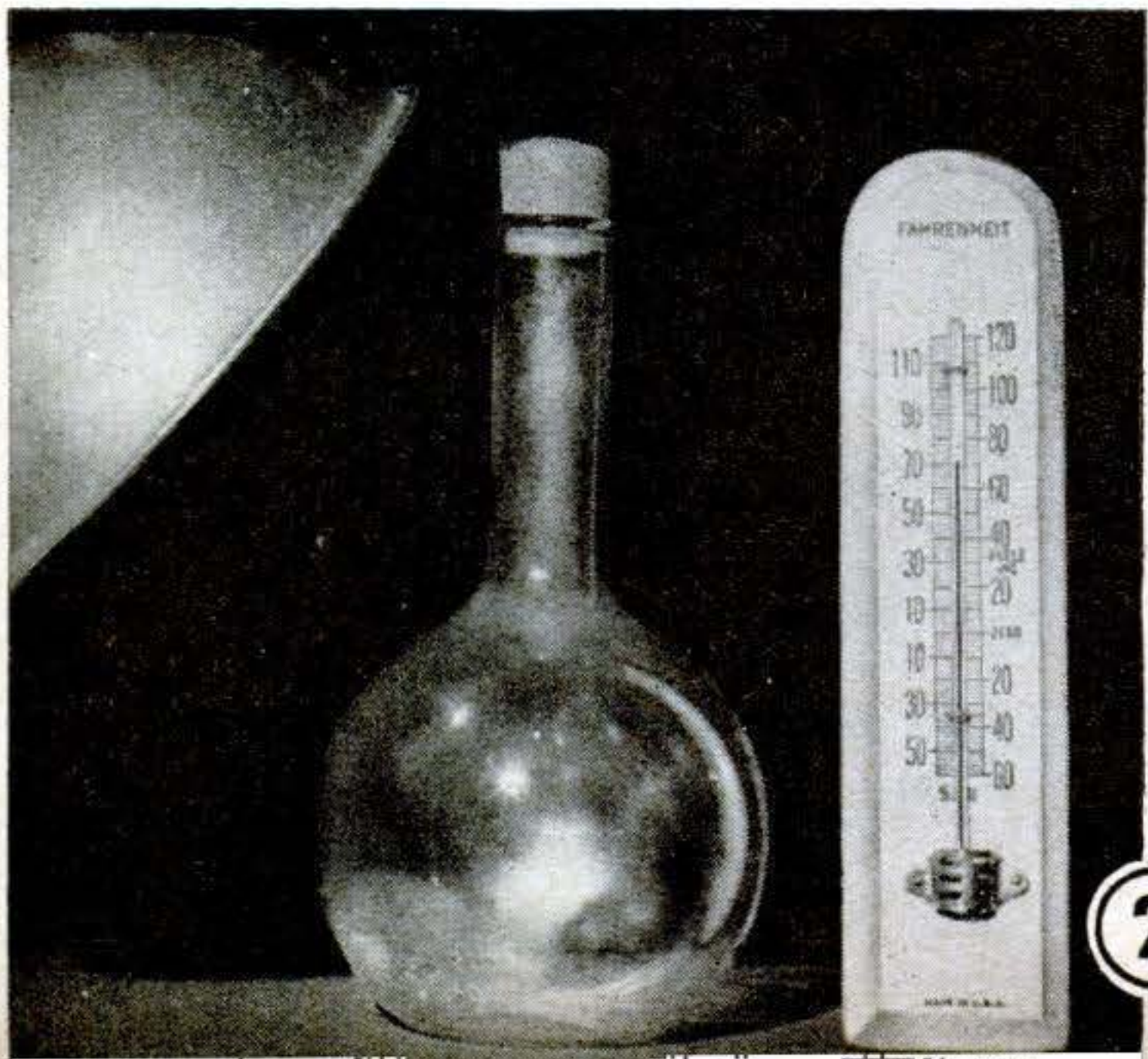
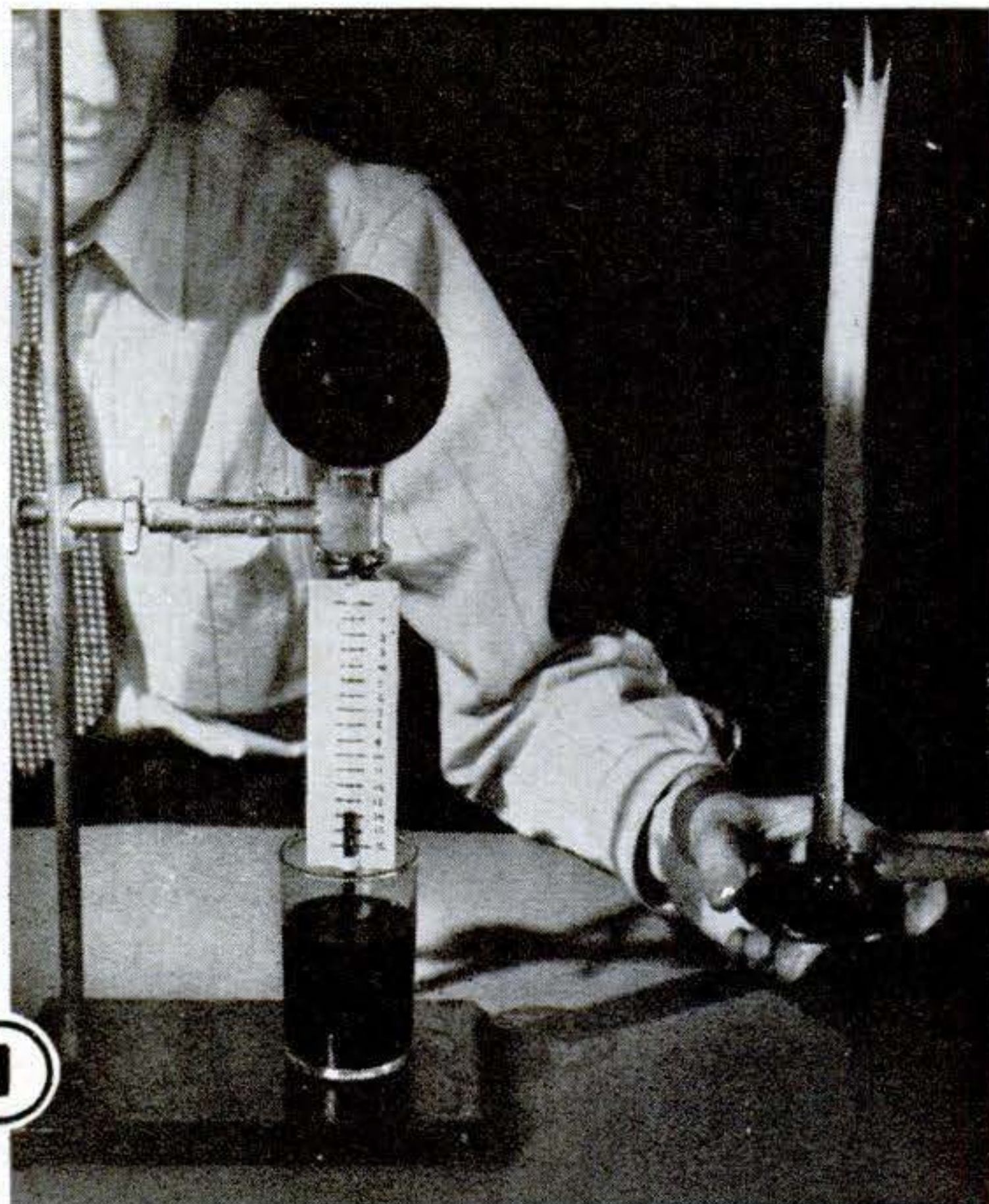
home EXPERIMENTS

1 A BLUE GAS FLAME is much hotter than a yellow one, but heat from the latter can be felt more strongly at the side, as can be shown with an air thermometer such as the one pictured below. A small flask with a one-hole stopper through which runs an 8" length of glass tubing will serve as a thermometer. Smoke the flask so it will absorb heat rapidly, invert it while warm in a glass of colored water, and place a ref-

erence scale behind it; then let it cool to raise the liquid to a convenient height. Now stand a Bunsen burner about 12" to the side and let it burn first with a blue flame and then with a yellow. Heat from the yellow flame will expand the air in the flask and depress the indicator fluid further than will that from the blue flame. This is because heat waves—similar to light waves but invisible—are radiated from the yellow flame by luminous, incompletely burned particles of carbon. Less loss of heat by radiation helps keep the blue flame hotter.

2 BREATHE INTO A FLASK and stopper it tightly as soon as the inside is coated with condensed moisture. Although the moisture cannot get out, it will disappear

FIVE SIMPLE EXPERIMENTS IN THE HOME LAB SHOW



if the flask is warmed. To show it is still present, let the flask cool, and the moisture will condense again. At room temperature, the air in the flask is saturated with moisture, but it readily takes up more as its temperature is raised.

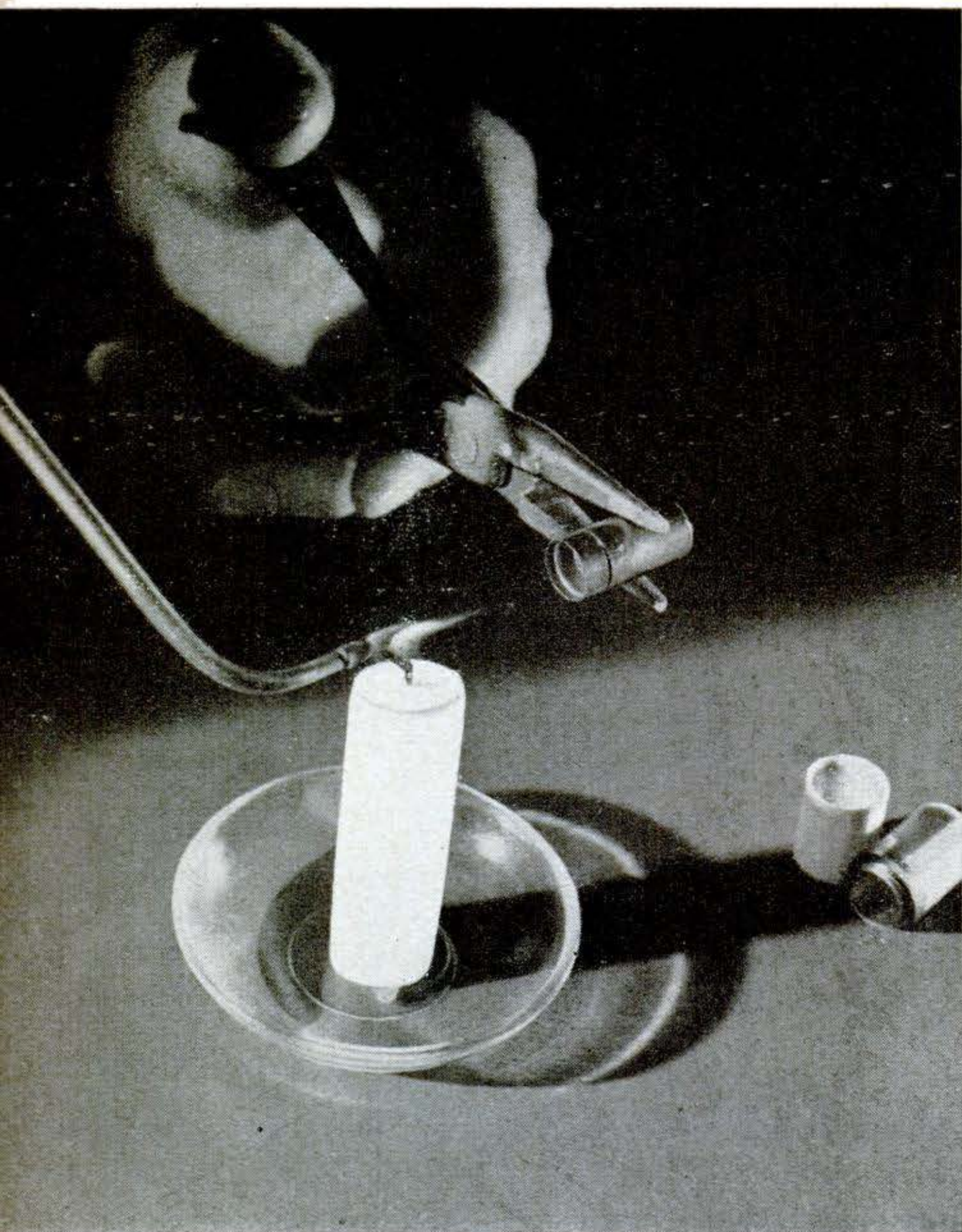
3 BLACKEN ONE SIDE of a tin can with smoke from a candle flame; then fill the can with boiling water. Hold one hand near the smoked half and the other near the bright side, and you find heat thrown off from the dark side considerably greater. This is because the bright metal retains heat longer. In practice, dark-colored steam radiators and cooking pots with blackened bottoms prove more efficient for their purpose than bright ones.

4 FIRE MAKES WATER when a cold flat-iron is held over a gas flame. On combustion, hydrogen in the gas combines with oxygen and collects as moisture on the iron. It would evaporate if the iron were hot.

5 HEAT AND LIGHT WAVES, though similar, do not always travel with equal ease through the same mediums. Support over an electric bulb a glass containing crystalline alum, which passes light readily, and another containing a strong solution of iodine, which is opaque to light. A thermometer will register higher when held over the iodine than it will over the alum, showing that the former passes more heat rays. Put into the substances, it will show that the alum, absorbing more heat, is hotter.

ODD FACTS ABOUT THE PROPERTIES OF HEAT AND FLAME





Catalysts

... SECRET AGENTS OF CHEMISTRY

By KENNETH M. SWEZEY

BY MEANS of a new catalytic oil-cracking process, American industrial chemists claim they can now produce a superfuel which is superior to any gasoline heretofore commercially available. Mix this fuel with ordinary gasoline, and present airplanes will travel faster or carry greater loads. Use it alone, and the fuel permits the design of engines tremendously more powerful and faster than those used today.

Once more a catalyst has worked a miracle, and by so doing has again attracted the attention of the public to one of the most mysterious and fascinating subjects of modern chemistry.

In newspapers, schoolbooks, and in these home chemistry articles, we have read how

catalytic processes help make sulphuric and nitric acids, ammonia, dyes, alcohol, plastics, synthetic rubber. In hundreds of other processes we seldom hear of, some catalyst is equally vital. Just what is a catalyst, and how does it work?

The answer to the first part of the question is easy, but the second poses a problem which chemists have never solved satisfactorily. A catalyst is a substance which can change the speed of reaction between two or more other substances, without being permanently changed or used up. Jokingly, it has been called a chemical parson—an agent which can bring about the union of other substances and yet remain unchanged itself.

Sometimes the speed of reaction can be accelerated by a catalyst to such a tremendous degree that the catalyst seems to *produce* the reaction. Take a little mound of dry baking powder, for instance. As long as this powder remains perfectly dry it might remain almost indefinitely without decomposition. If you add a few drops of water, however, the seemingly inert powder immediately froths up with volumes of gas. Plain water has in this case acted as a catalyst, helping the acid compound and the sodium bicarbonate to unite, liberating carbon dioxide. The water is not changed by the reaction.

Water is probably the most universal catalyst. Many chemical reactions apparently cannot take place without at least a trace of moisture. You can easily demonstrate a violent and vivid reaction

between normally nonreactive materials, initiated by a single drop of water. Because of the dense, choking fumes produced, it is best to perform this experiment outdoors, or near an open window.

Powder some dry iodine crystals in a mortar and mix thoroughly with this powder an equal volume of powdered aluminum, first making certain that both substances are absolutely dry. Place a little mound of the mixture on the center of an asbestos pad. Now add a drop of water in a depression on top of the mound, and stand back. Almost instantly, purple-red vapors rise from the heap. In another second, the mound bursts into beautiful purple-red flame, accompanied by great volumes of smoke.

Berzelius, the great Swedish chemist, devised the term catalytic agent in 1836. Long before that, however, catalysts had been used. Sulphuric acid, for example, served as a catalyst in making ether—or “sulphuric ether,” as it is sometimes still called. Ether—or, more properly, ethyl ether—is produced from ethyl alcohol when two molecules of the alcohol lose one molecule of water. Sulphuric acid helps remove the water.

To demonstrate this transformation in your home laboratory, pour about 2 ml. of denatured alcohol into a test tube and carefully add an equal amount of concentrated sulphuric acid. Pour in the acid very slowly, mixing the solution cautiously with a glass stirring rod. Now heat the mixture gently over a small alcohol or Bunsen flame. Keep the tube turned away from you, and do not bring the mixture to a boil. This experiment is entirely harmless if you follow directions; the cautions are merely to prevent any spilling or spattering of the strong acid, which might cause serious burns to yourself or damage to your workbench.

After heating the acid-alcohol mixture for a few seconds, pour it into about 20 ml. of warm water in a beaker. The presence of ether can immediately be detected by its smell. The sulphuric acid is merely diluted by the water removed from the alcohol during this reaction. None of the acid is otherwise altered or lost.

A common home chemistry experiment shows how manganese dioxide serves as a catalyst to release oxygen from hydrogen peroxide. Here is a method of demonstrating this catalytic process even more vividly. Pour a little hydrogen peroxide into a tall glass or beaker and mix with this a few drops of some soapless shampoo. Now drop in a few grains of powdered manganese dioxide. Instantly, oxygen released from the decomposing peroxide starts making foam, and if enough solution is used, the foam will finally overflow the glass.

Perhaps without realizing it, you use a catalyst every time you mix a drier into paint. The drying of linseed oil is not merely evaporation, such as occurs when turpentine dries. It consists of a hardening

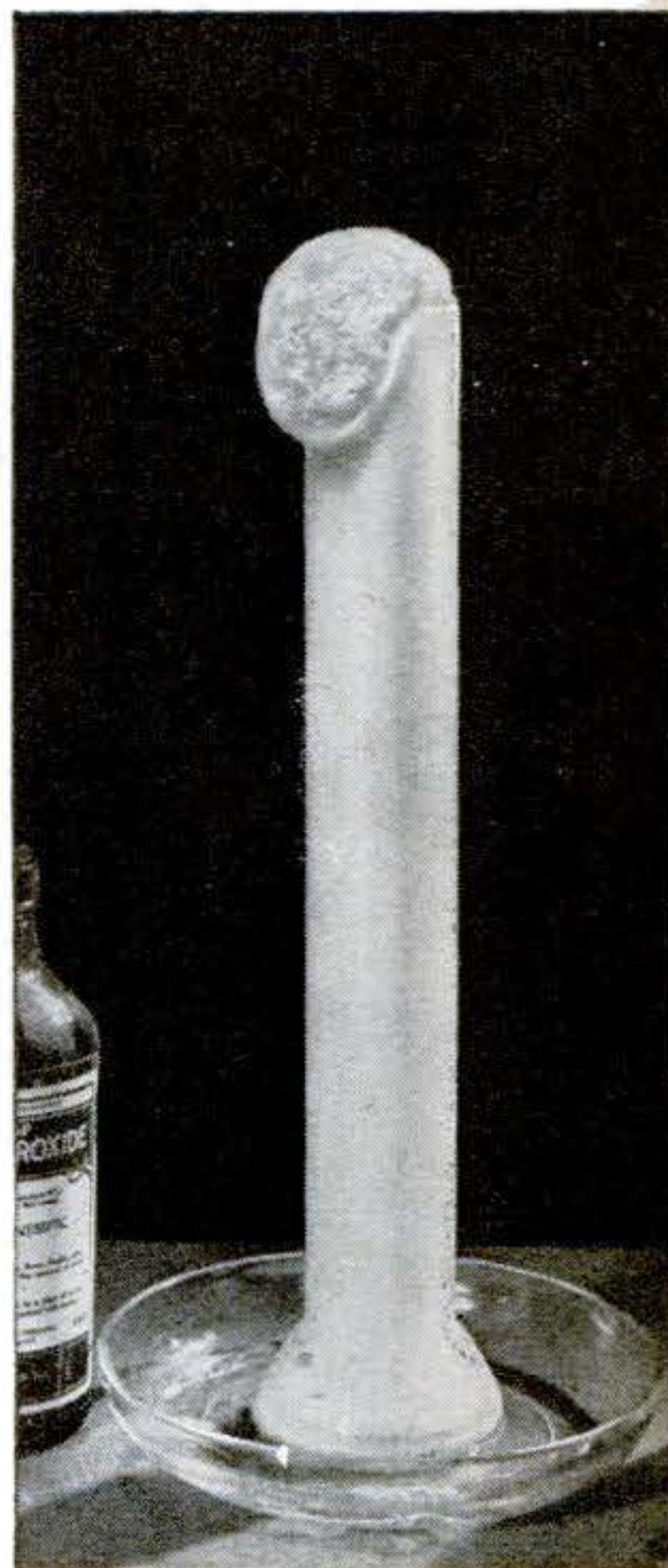
of the oil into a tough film, caused by oxidation of the oil. Driers, which usually consist of borates or resins of manganese, cobalt, or other metals, help hasten this oxidation.

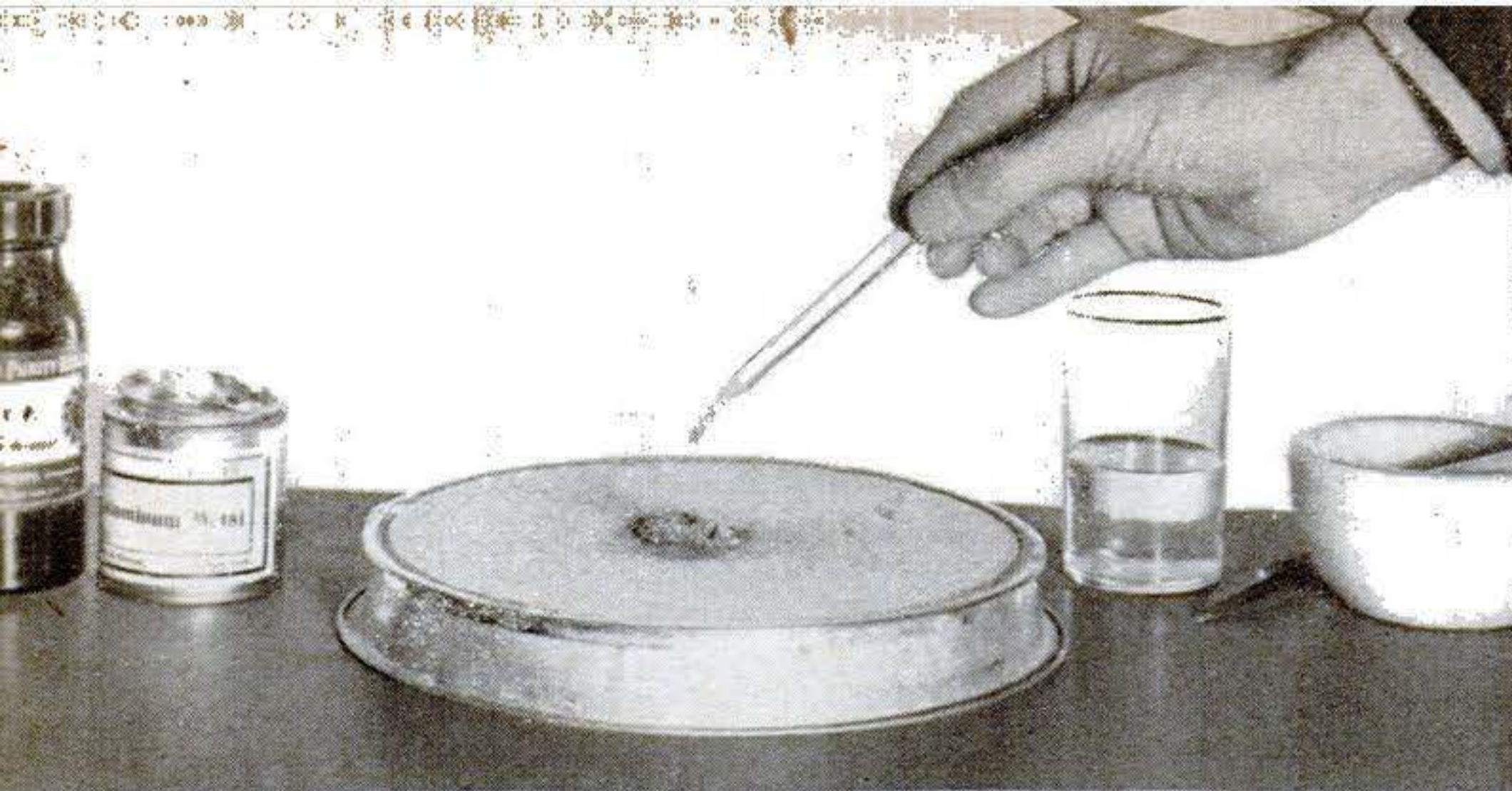
You can easily make some manganese borate, a typical drier, and find out for yourself how it works. Dissolve a little borax in one portion of water, and a little manganese sulphate or chloride in another portion. If you now mix the two solutions, a flesh-colored precipitate of manganese borate will form. This substance is recovered by filtering off the liquid. While still on the filter paper, it is washed with water to remove impurities and is then dried.

Now paint two strips of cloth with linseed oil—one with plain oil, and the other with oil in which a few grains of the manganese borate have been mixed. After exposure to the air for a day, the cloth coated with linseed oil containing the drier becomes dry and stiff; while the other cloth, coated with plain linseed oil, is still limp and wet.

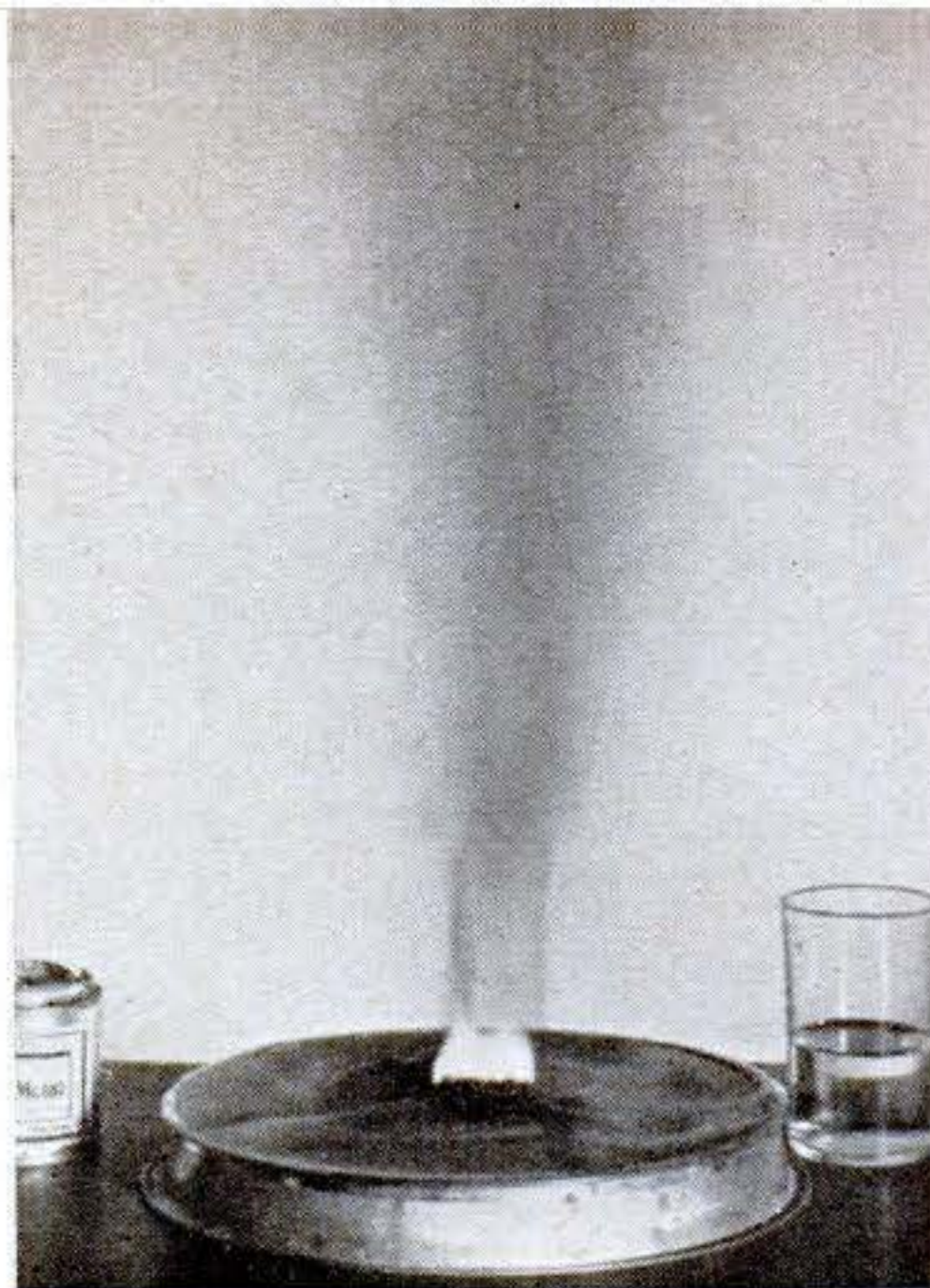
The catalysts thus far mentioned have been powders or liquids which have been mixed with the substances between which they have promoted a reaction. In another type of catalyst the reaction occurs when gases or other substances are caused to unite by being strongly adsorbed together on the surface of some metal, such as spongy

When a catalyst, a few grains of manganese dioxide, is dropped into a tall beaker holding some hydrogen peroxide, a rapid decomposition of the peroxide ensues. If shampoo is added, liberated oxygen makes foam





Water is often a catalyst. Here a single drop, added to powdered iodine crystals and powdered aluminum, is sufficient to make the mixture burst into colorful flames. Do this in a ventilated room



platinum, platinum black, copper, or finely divided iron or nickel.

The flameless, sparkless stove lighters of the past, as well as modern flameless cigarette lighters, depend for their operation on catalysts of this type. In these lighters, illuminating gas in the first case, and alcohol vapor in the second, oxidizes vigorously upon touching the surface of a platinum or palladium catalyst. The intensity of the reaction causes the catalyst to heat up to redness.

When lighters of this kind fail to work properly, the trouble often springs from a "poisoned" catalyst, a condition produced by an accumulation of dirt or soot on the surface of the catalytic metal. (Because an extremely small quantity of an impurity can affect the power of a catalyst, chemists sometimes use this fact to make sensitive analyses. For example, very minute concentrations of cyanide can be detected by their effect in reducing the catalytic activity of platinum.) If your flameless cigarette lighter has a catalytic element coated with soot, you can usually renew it by holding the unit for a few seconds in the tip of a blow-pipe flame, as shown in the photo on page 190.

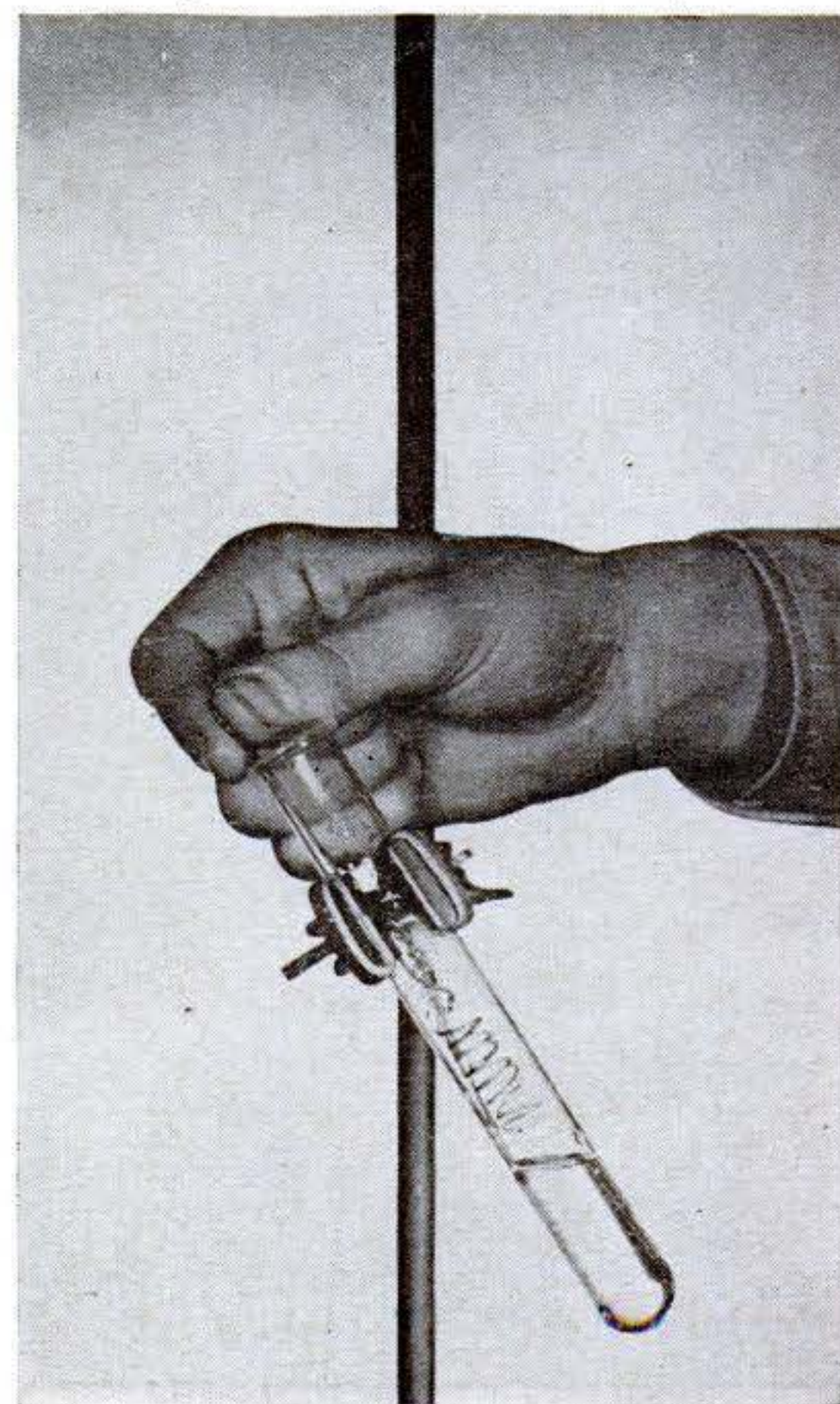
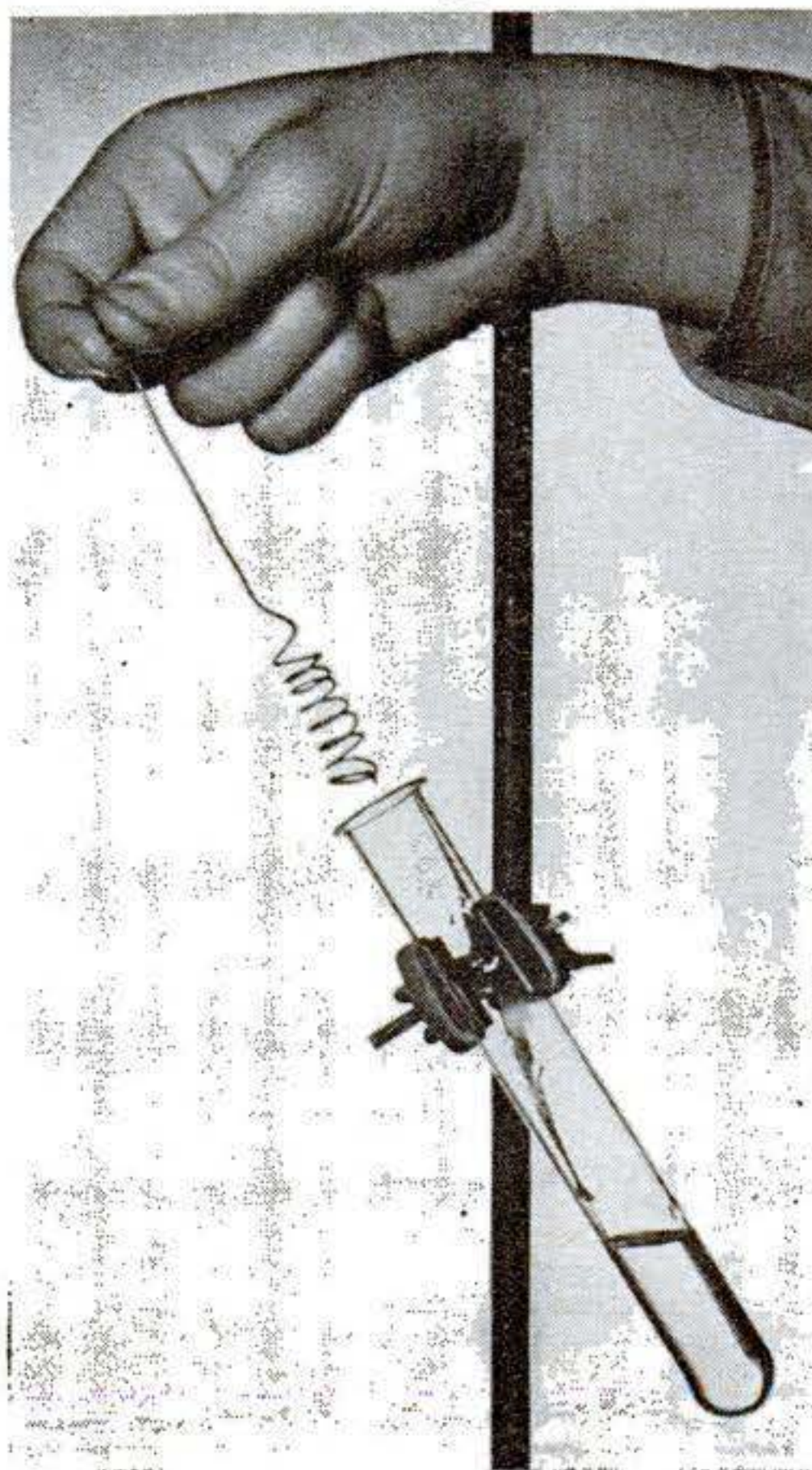
Smooth copper screening is used as a surface catalyst in changing methyl alcohol into formaldehyde by a process of slow oxidation. This reaction can easily be demonstrated with the

aid of a small spiral of copper wire. Procure about eight inches of No. 14 or 18 bare copper wire and form the end into a spiral by winding it around a pencil.

Gently warm a little methyl alcohol in a test tube. Heat the copper spiral in a Bunsen flame to dull redness, and then plunge this coil into the vapor in the test tube. Any coating of black copper oxide which may be on the wire immediately vanishes, and the pungent odor of formaldehyde issues from the tube. The hot copper causes the alcohol vapors to unite with oxygen from the air and from its own oxide.

Fame awaits whoever solves the mystery of why catalysts produce their results.

Metallic catalysis can be demonstrated with a spiral of bare copper wire heated to a dull redness. Placed in the vapor of warm methyl alcohol, it causes an alcohol-oxygen reaction, indicated by an odor of formaldehyde



TRICKS WITH Soap Bubbles

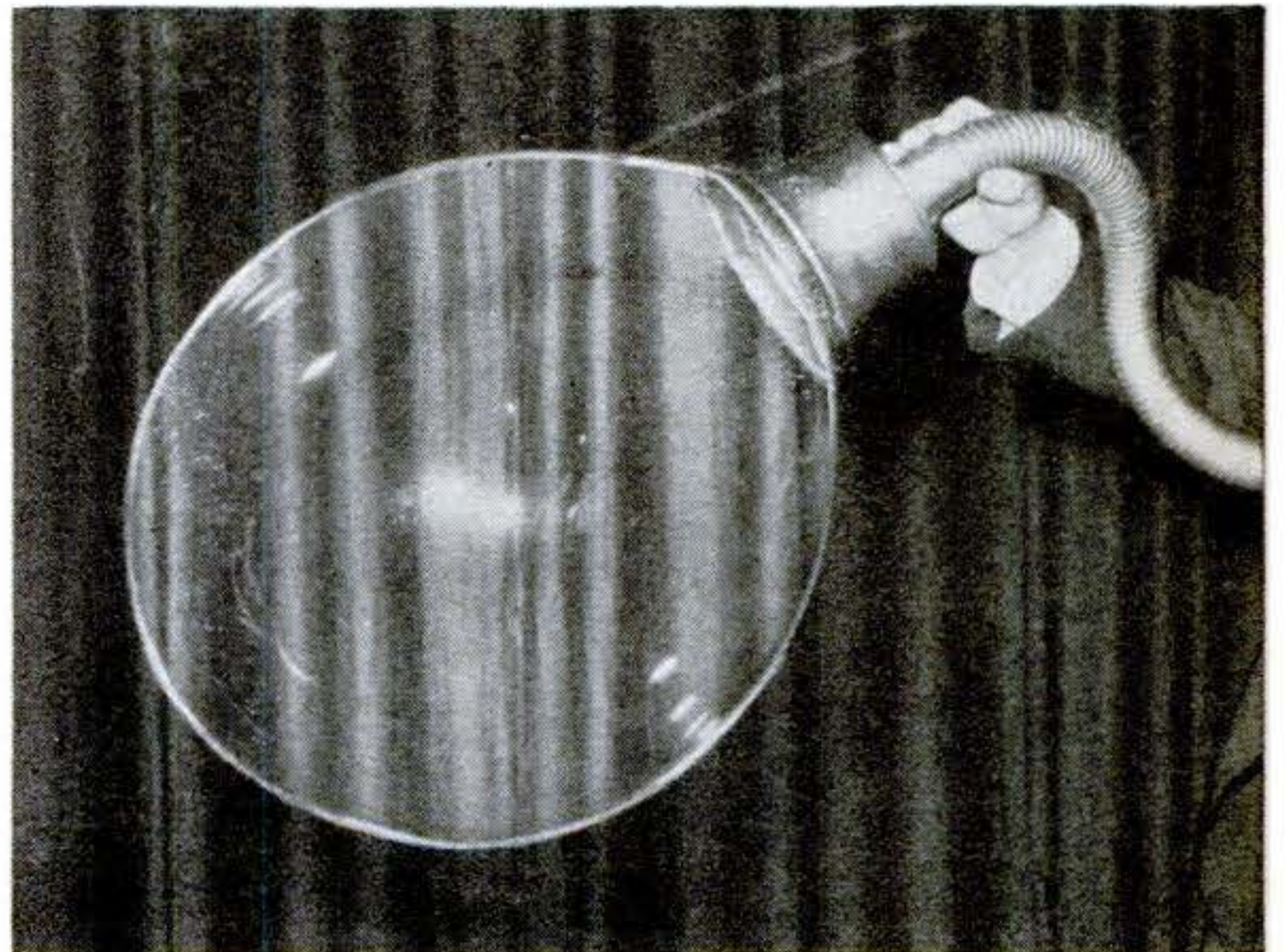
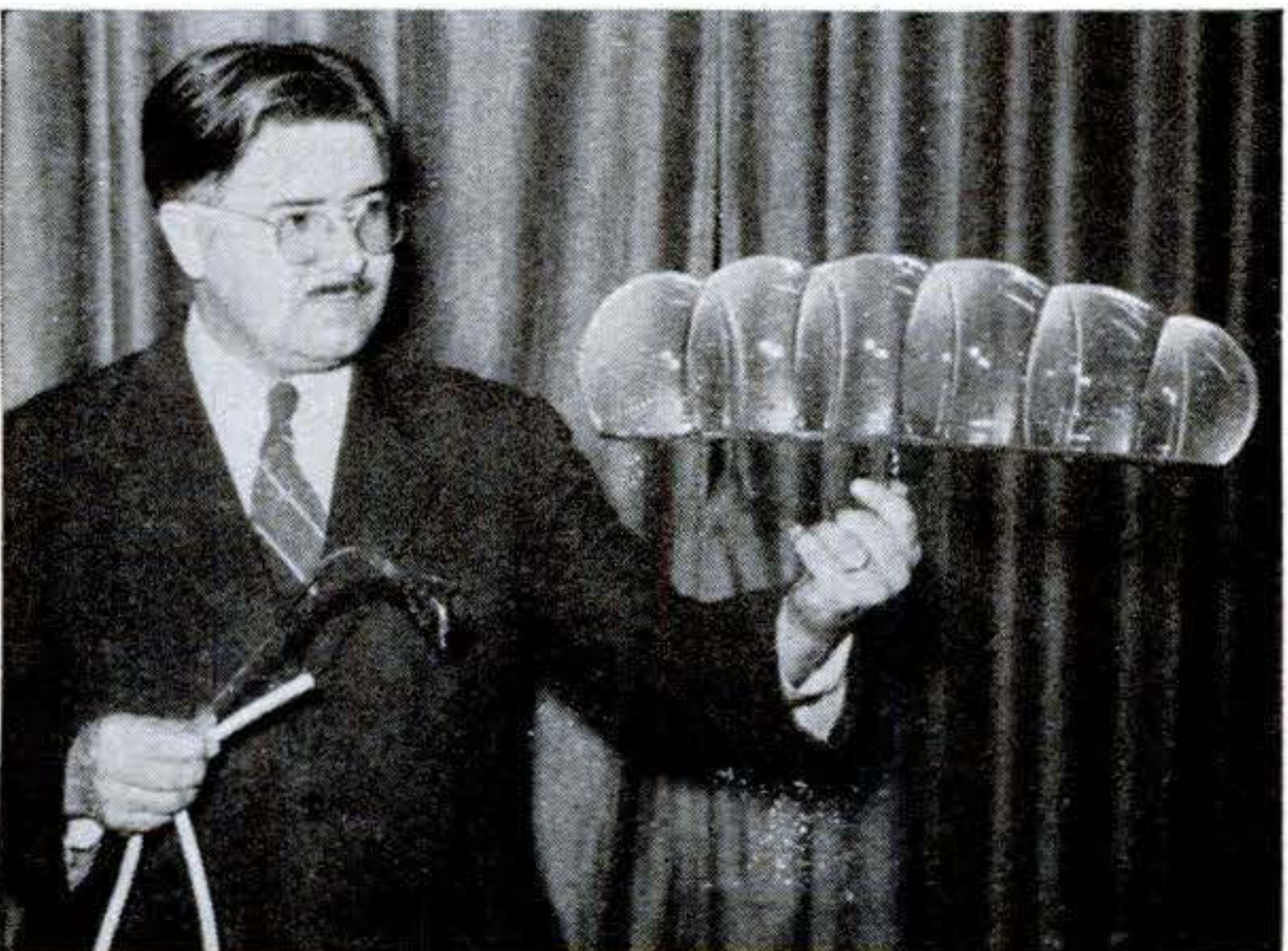
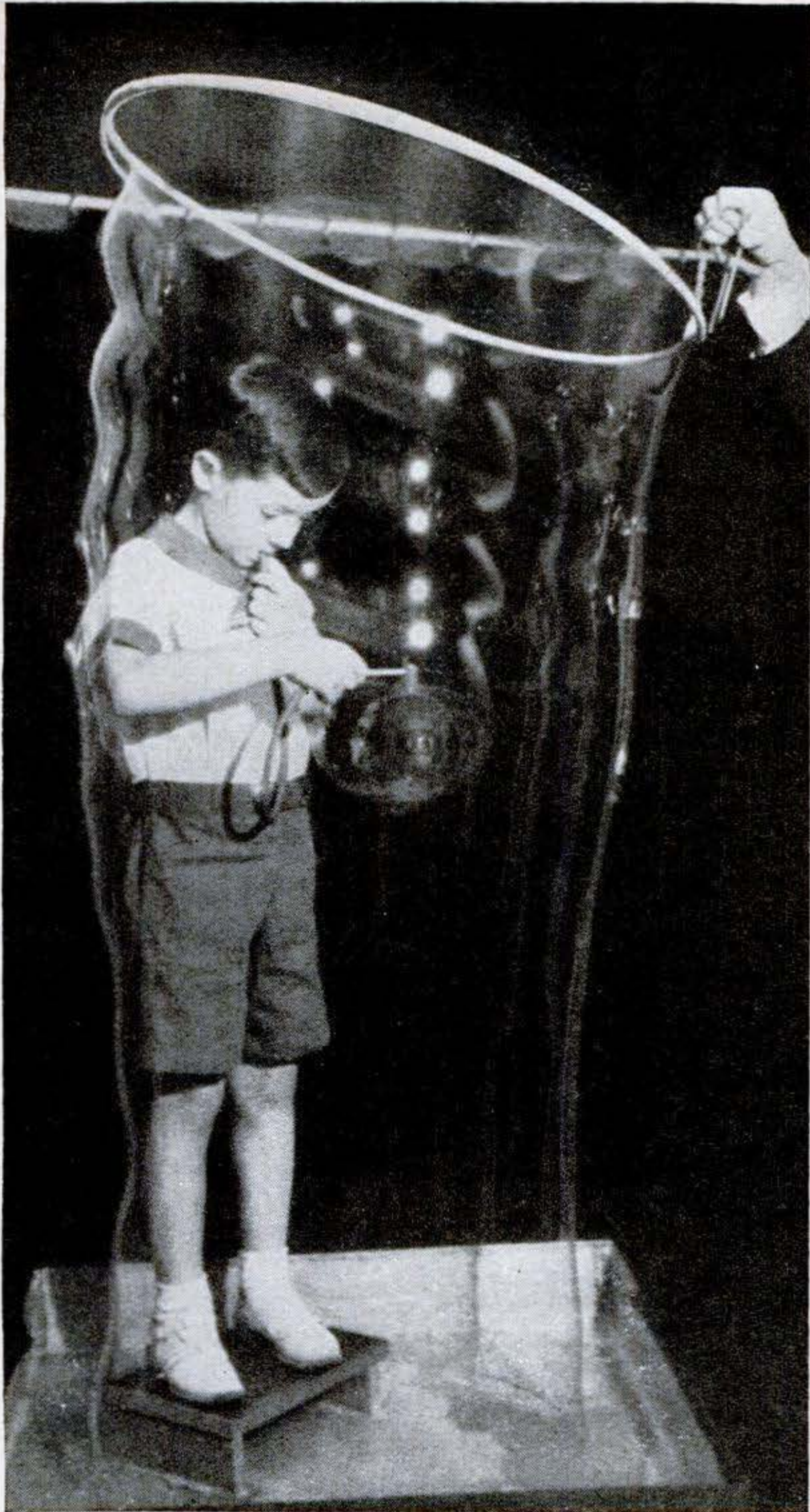
A SPECIAL solution, simple equipment, and a little practice will produce amazing soap bubbles and a whole routine of surprising tricks. Mix 8 oz. of distilled water or rain water, 1 oz. pure Castile or palm-oil soap shavings, and 4 oz. of pure glycerin. Add the glycerin when the soap has dissolved, stir thoroughly, and siphon off the clear liquid which will collect at the bottom.

A glass tube 1" in diameter, with the bubble-forming end cut at a 45-deg. angle, will serve for blowing medium-sized bubbles, while a large funnel or bell-shaped reflector will make bubbles up to 2' in diameter. Another way to produce giant bubbles is to bend a wire coat hanger into a large loop, immerse it until a film covers the loop, and then swish it through the air.

By using a hydrogen generator and tubing with a T-shaped fitting, bubbles can be filled with an air-hydrogen mixture; they will soar like balloons and explode if touched with a lighted cigarette. If a loop of fine aluminum wire with a thread tied to it is coated with a film and a gas-filled bubble is placed on the ring, light objects on the thread can be floated in the air.—R. M. LUTHER.

A quick upward motion of a large ring encases a boy, who is himself blowing a bubble, within a cylinder of soap film. Below, Eiffel Plasterer, an Indiana teacher who has made bubbles a hobby, displays a bubble chain

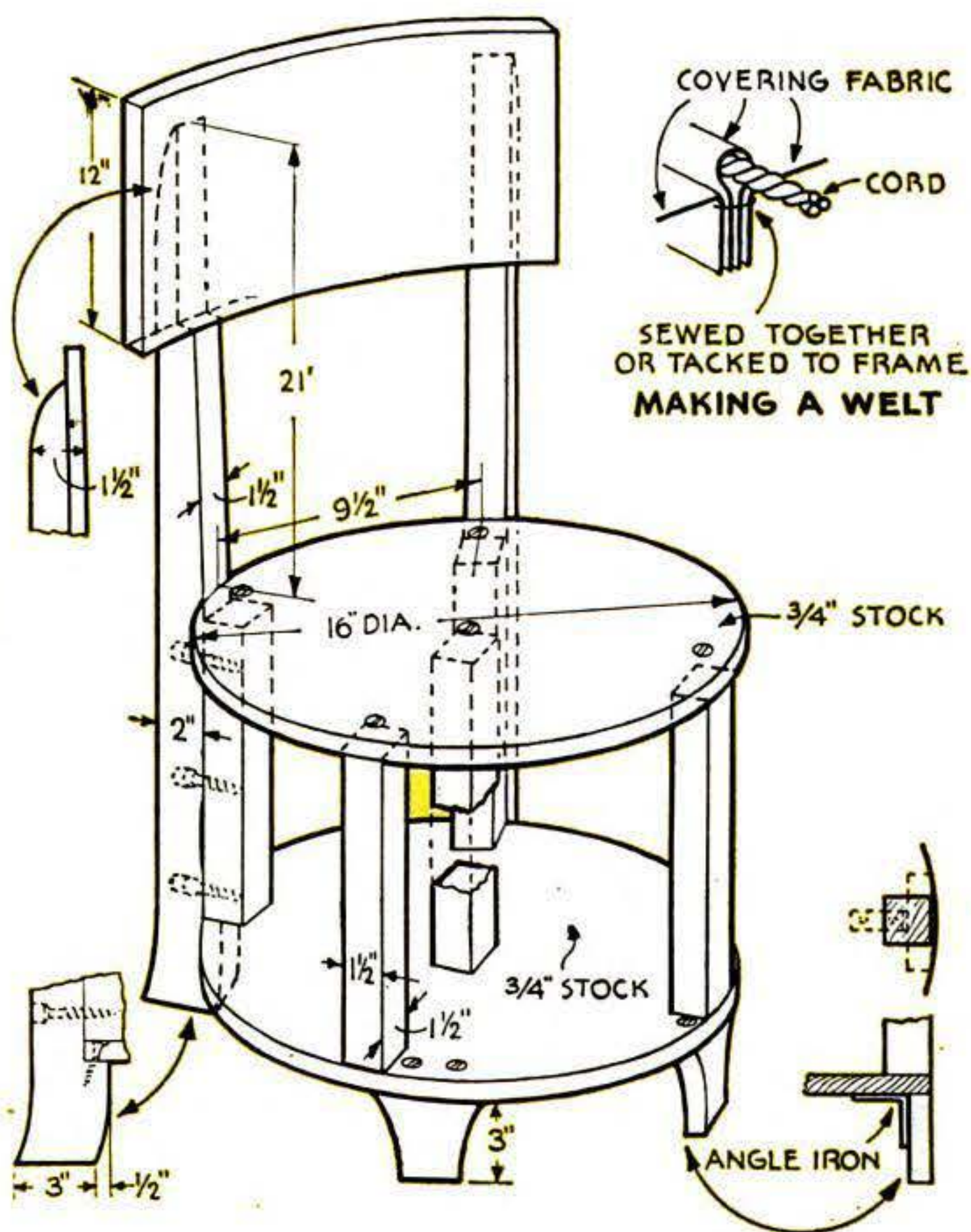
Bubbles 2' in diameter can be made with an old vacuum-cleaner hose attached to a flaring metal utensil. Use glycerin to increase bubble life. Mr. Plasterer has blown one that lasted 180 days





Vanity Chair Adds

HOMEMADE FRAMEWORK CAN BE



CREATING and finishing a circular bedroom chair will prove to be an interesting project as well as provide an appreciated gift for a friend. The frame for the chair can be rough, but it must be well put together. The style of upholstering and the type of covering should harmonize with the furnishings and colors of the room where the chair is to be used. Flowered chintz or cretonne, or an over-all conventional pattern are appropriate, and the chair can be upholstered with or without a pleated skirt, as shown in the photos.

The frame for the chair includes two pieces of $\frac{3}{4}$ " wood 16" in diameter. It is not necessary that these round pieces be of solid wood, or even made up of glued pieces. Separate boards can be held together with cleats fastened to the inside surfaces where they will be hidden from view by the upholstery.

Cut five pieces of $1\frac{1}{2}$ " by $1\frac{1}{2}$ " stock 13" long. Screw two of these fast to the bottom disk $9\frac{1}{2}$ " apart, two others at equal intervals around the disk, and the fifth in the center. Fasten the upper disk atop these. Shape two tapering back posts $38\frac{1}{2}$ " long. Either tapered or turned front legs may be used, but they should be held firm with angle irons. Rear legs are formed by the back posts. The

STEP-BY-STEP OPERATIONS



Burlap pinched around cotton stuffing is tacked to the seat to form the soft bulge of a roll edge

Luxury Touch to a Bedroom

UPHOLSTERED WITH EITHER PLEATED OR TAILORED COVER

height of the frame allows for 1½" of seat stuffing, so the chair seat will be 19" above the floor when completed.

A curved back rest can be made from several pieces of thin wood bent and glued up to the desired thickness, or one wide board can be kerfed, steamed, and bent. Another way to make a curved back is to cut three sections from barrel staves.

After the frame has been completed, cover the entire side with burlap or some other heavy fabric, and tack a strip of burlap around the upper, outer edge of the frame. Then pinch this burlap around cotton stuffing sufficient to form a roll edge that will bulge about ½" beyond the seat all the way around. Close the roll by tacking the pinched-in edge of the burlap to the top of the seat, as shown in the photo on the facing page.

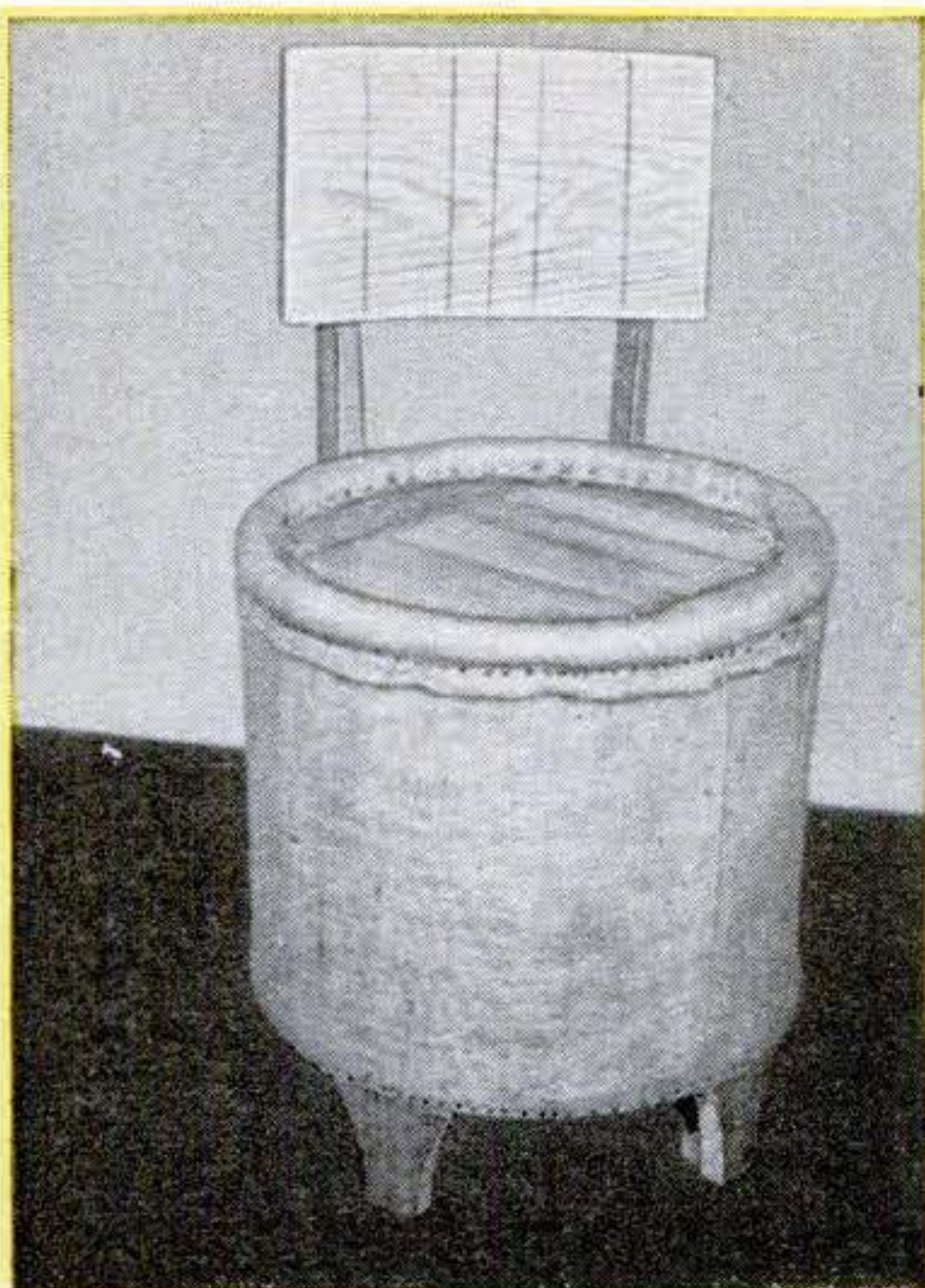
Fill the top with stuffing, and tack the fabric cover evenly all around, directly under the roll edge. A welt, which is a cord covered with fabric, is then tacked all around. On the chair with plain, tailored sides, a layer of cotton felt is placed all around and covered over with fabric. On

the pleated-skirt chair, it is not necessary to use cotton felt on the sides, a piece of white, unbleached muslin tacked over the burlap being sufficient.

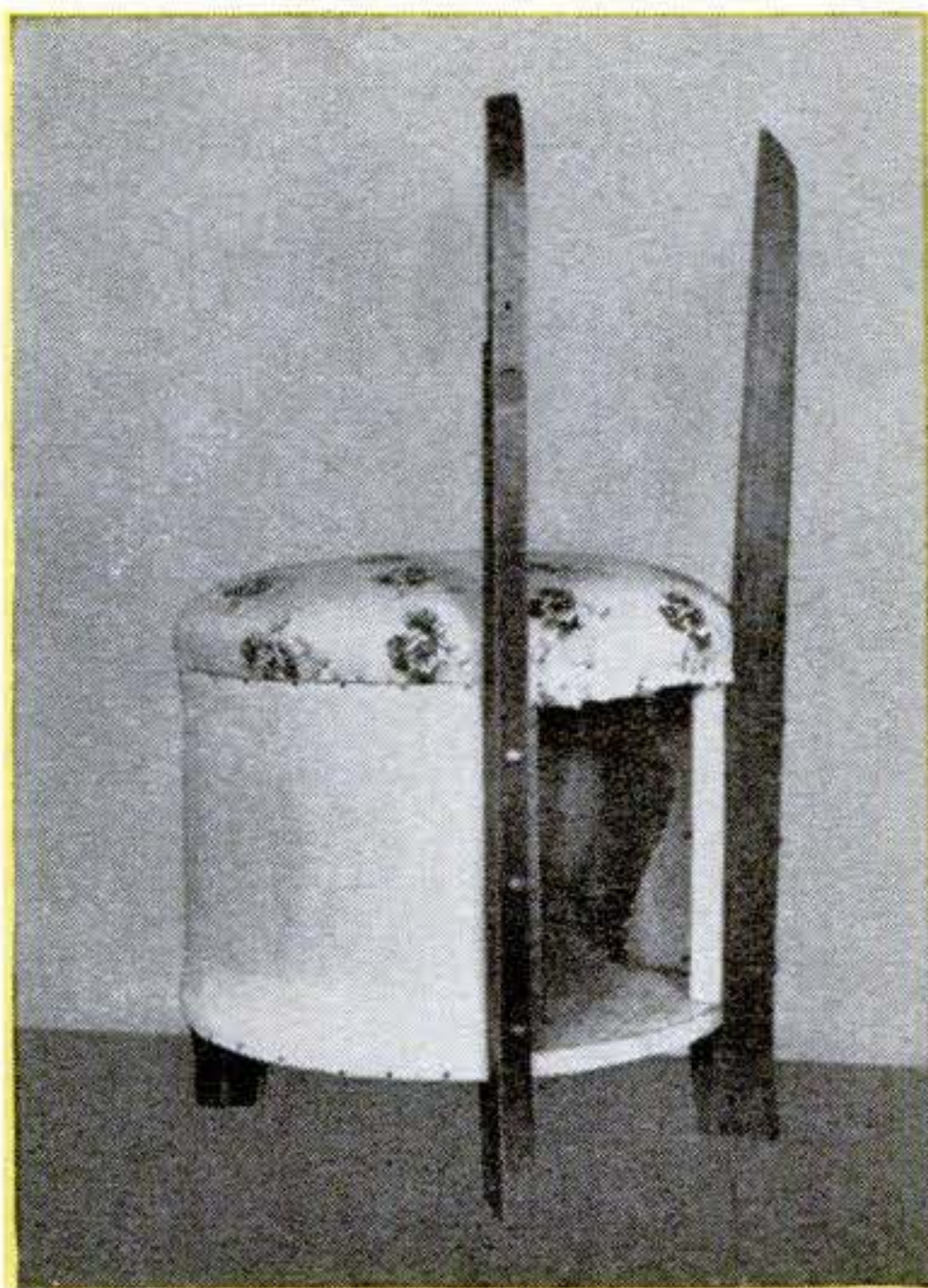
After a trial fit on the back posts, unscrew the back rest and upholster it, first dividing it into five equal sections. For the three middle sections, cut a piece of material 3" wider than their width, and cut two pieces for the end sections 5" wider, allowing enough material for tacking to the rear of the frame. Sew all five pieces of material together, and tack the seams to the marked sections on the back.

Fill the sections with cotton felt, beginning with the center section and filling end sections last. Tack a cover to the rear of the back. This cover for the rear of the back should be large enough to permit the edges to be turned under and tacked on with gimp tacks or to be sewn by hand to the edges of the front cover fabric that has been drawn over and tacked. Sewing of upholstery on a frame is best done with upholsterer's straight or curved needles. Finish the wood as desired.—HERBERT BAST.

IN PADDING AND APPLYING THE UPHOLSTERY



Legs and back posts are put on, and the curved back is screwed in place



The seat is covered and muslin put on the side, ready for the pleated skirt



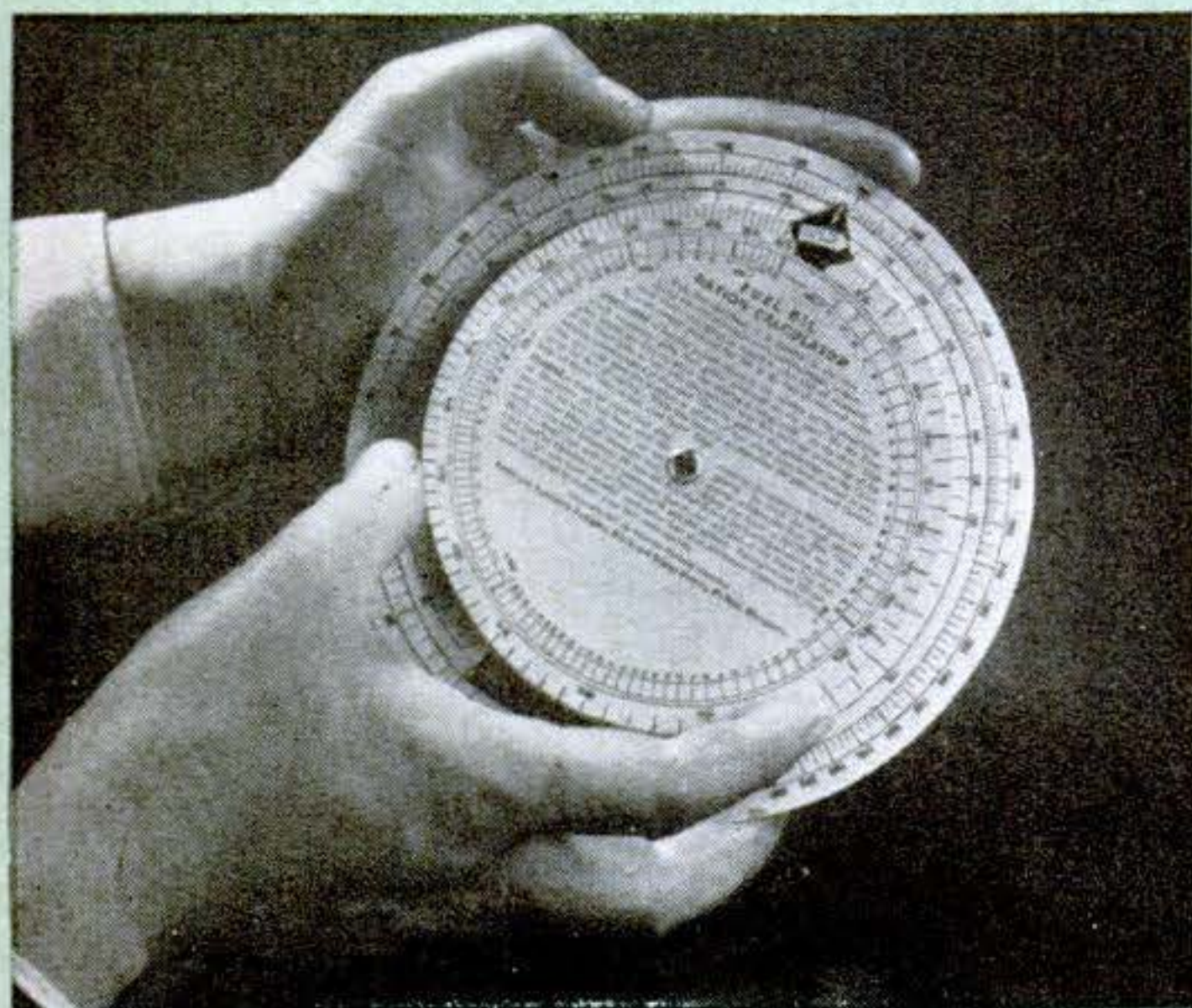
For a tailored effect like this, one layer of cotton felt is applied before the side covering is put on. The same framework is used. In the photo at left, part has been left uncovered to reveal the construction

OF INTEREST TO



HOME OWNERS

FUEL-OIL CONSUMPTION in rationed areas can be checked instantly for any time of year with the aid of the dial calculator shown below. The pointer is placed opposite the annual fuel allotment, and a reading on the circumference of the disks will give the amount—based on authentic degree days and temperature charts—that may safely be burned in any day, week, or month to keep within the limits of the total allowed.

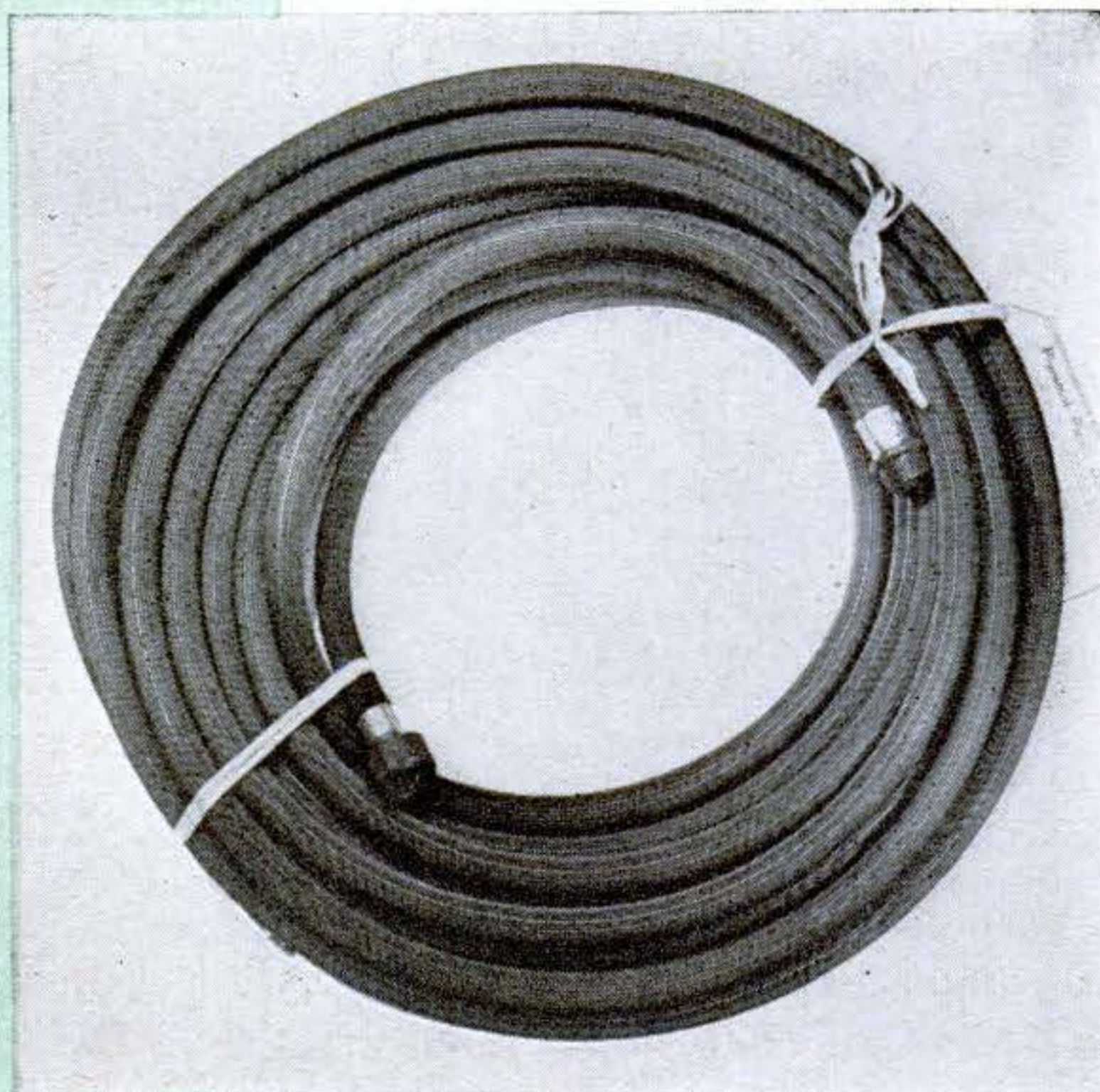


MODERN CEDAR CLOTHESPRESSES can be made from old closets simply by papering with a wallpaper that is actually manufactured from cedar wood and is treated to retain its odor. The paper comes with an adhesive base, can be applied quickly after preliminary immersion in water, and has a grain finish.

Bathtubs and Garden Hose of New Plastic Construction

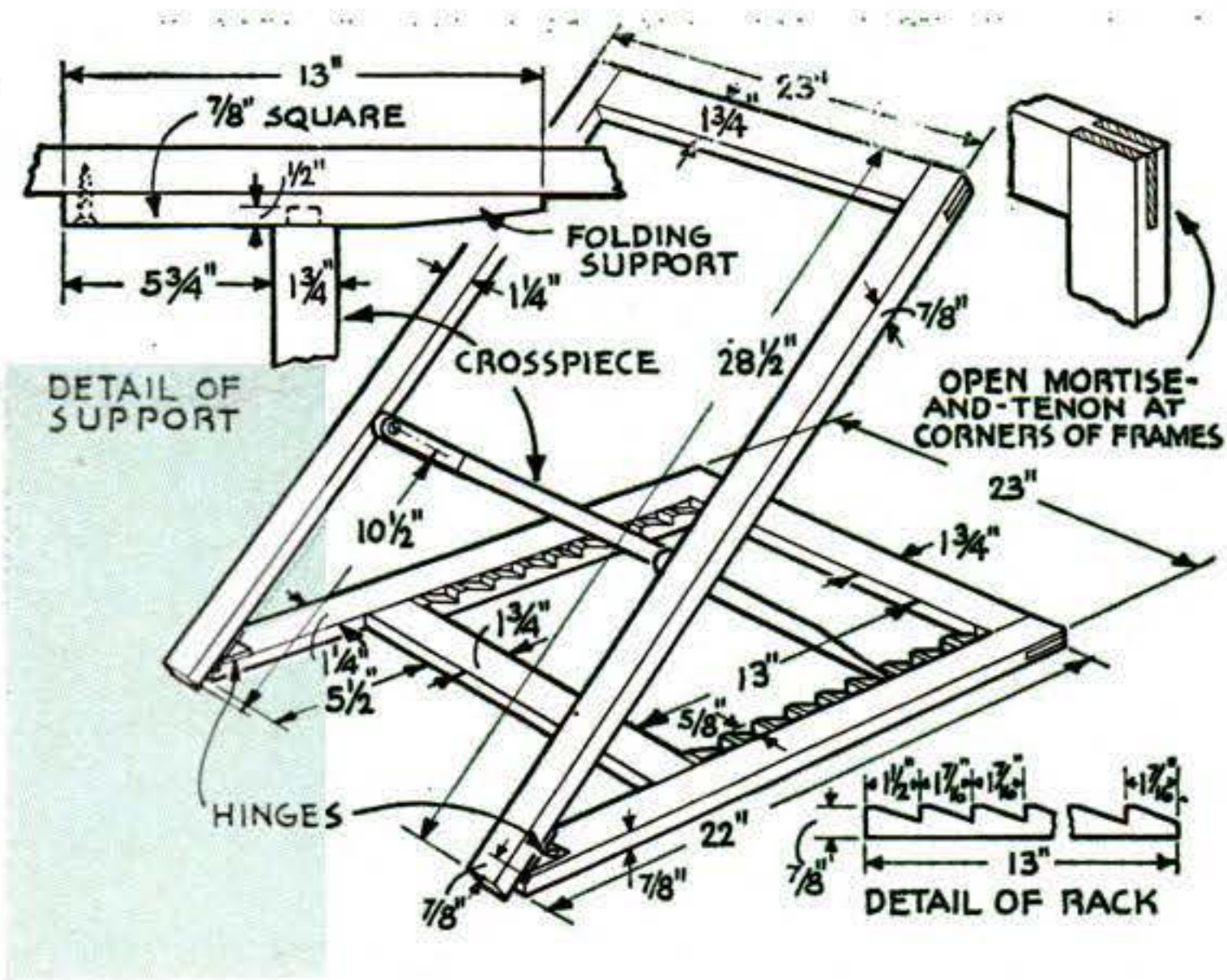
USE of versatile plastics has now been extended to both bathtubs and garden hose—the former a hard, rigid unit with a synthetic-enamel finish resembling that of a metal tub, and the latter a flexible length of tubing much lighter in weight than rubber and capable, the manufacturers say, of withstanding more pressure.

The over-all dimensions of the tub are 14" by 28" by 58½", suitable for installation in the average bathroom. Plastic hose, made only in ½" size, is available in 50' lengths with couplings and can be connected to an ordinary rubber hose.



POPULAR SCIENCE

Back Rest for Use in Bed Has Folding Frame and Quickly Adjustable Angle



LIST OF MATERIALS				
No.	Pc.	Description	T.	W. L.
2	Sides	7/8	1 1/4	28 1/2
2	Sides	7/8	1 1/4	22
2	End rails	7/8	1 3/4	23
1	Middle rail	7/8	1 3/4	22
1	Support brace	7/8	1 3/4	19 3/4
2	Supports	7/8	7/8	13
2	Saw-toothed racks	5/8	7/8	13

MISCELLANEOUS: 1 pair hinges, 24" length of webbing, 26"x30" cover fabric, and 2 1 1/2"—No. 10 flathead screws.

Note: All dimensions are given in inches.

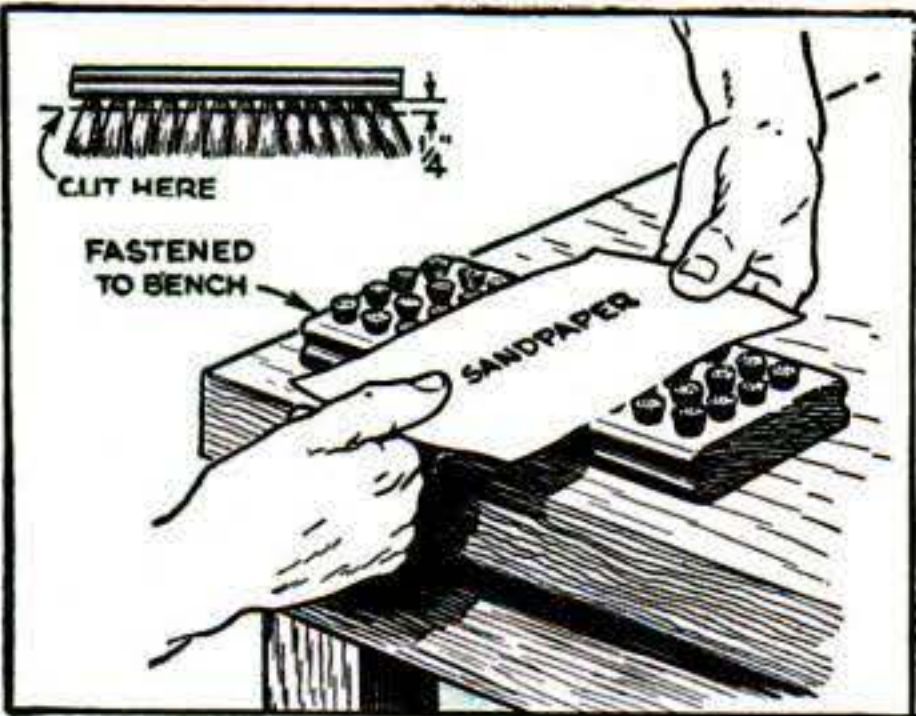
No rigid brace that will cause discomfort is used behind the fabric covering the adjustable back

REALLY comfortable back rests are indispensable for invalids, and they are always a convenience to persons who like to read in bed. Such a back rest can be made of two frames hinged together. It folds flat and is adjustable to various angles to suit the preferences of its users.

The upper frame has two sides and one end rail, while the lower frame has two sides, one end rail, and one middle rail. Sides and end rails are joined with open mortises and tenons, while the middle rail is blind-mortised into the sides. Be sure that the lengths between shoulders are alike on the three rails.

A saw-tooth rack is glued to the inside edge of each side of the lower frame. The supports, which rest on these racks, are joined with a brace mortised into them. They fit inside the upper frame, to which each is fastened with one countersunk flat-head screw. Taper the ends to fit into the saw-tooth racks.

The two frames are fastened together with hinges screwed on the faces of the side pieces, as shown in the drawing. Finishing will depend upon the kind of wood used, but the entire back rest should be perfectly smooth with all edges and corners rounded off. A piece of webbing is nailed across the bottom end of the upper frame before final covering with a strong and attractive upholstery fabric.—HERMAN HJORTH.



Scrubbing Brush Cleans Used Sandpaper

ONE or two rubs of an ordinary scrubbing brush will remove pulverized wood particles stuck in the grit of sandpaper and garnet paper, and thereby prolong the efficient cutting of the abrasive. An old scrubbing brush will serve the purpose as well as a new one if its bristles are cut down to a uniform length. If the brush is fastened to a wall or to the workbench, it will be handier for frequent use during a sanding job.—W. F.

Overhauling Corn Planters Pays

By E. W. LEHMANN

Head of Department of Agricultural Engineering, University of Illinois

JUST how important it is to keep a corn planter in first-class condition is best realized, sometimes painfully, when the planting season is over and the seed comes up. Then the farmer can tell how well or how poorly he planted by the stand he gets.

If the crop bids fair to be a good one, he should consider himself well repaid for time he spent on the maintenance of his planter.

It will be too late then to do anything about scrawny rows with skips and too few stalks if a defective planter, or one with wrong plates, was used. Moreover, a reduced yield will not be the only disadvantage of underseeding, because the cost per bushel of the entire crop will be increased. A poor stand costs as much as a good one to cultivate with a power cultivator and harvest with a corn picker.

Planting *more* than the proper amount of seed will likewise reduce the yield as well as increase the costs. Although experience has shown that up to a certain point an increase in yield can be obtained by increasing the amount of seed planted, overseeding will defeat that end.

To get a maximum yield of corn, at least three objects must be borne in mind in planting the seed. The proper amount per acre must be planted, the seed must be evenly distributed, and it must be planted at the right depth. All of these considerations should influence the testing, adjustment, and operation of planters. Plates must be selected according to the size and shape of the kernels, and it is essential that the planter be tested if the proper number of kernels are to be planted unfailingly in each hill.

The essential features of a corn planter are the feed mechanism, which is in the form of a plate with cells or spaces in which the kernels are carried to the outlet into the seed boot; the seed boot and valves for accumulating the desired numbers of kernels for each hill; the release mechanism for opening the valve to permit the seed to drop into the ground; the drive mechanism for operating the planter; and the furrow opener and seed-covering device. The drive mechanism includes shafts, wheels, a checking head, a clutch, sprockets, chains, pawls, and springs. On power-driven planters, there are special drive shafts as well.

Use of a check planter permits the cross cultivation of corn, because it lines the hills up both ways, facilitating effective weed control. The practice of check planting is widely followed in the Corn Belt. Valves in the seed boot are operated by buttons on a check wire stretched across the field. These buttons are spaced the same distance apart as the hills of corn are to be planted.

Corn planters are used only a few days each year, but adequate lubrication and careful adjustment of wearing parts will long delay the time when extensive repairs become necessary. In the annual overhaul clean all parts thoroughly, including the grain hopper or seed box, the fertilizer attachment, if there is one, and the feeding mechanism. Remove and clean all chains with kerosene; then put them in an oil bath. Replace badly worn sprockets and chains with new ones. See that the shafts turn



Dividends in Higher Yields

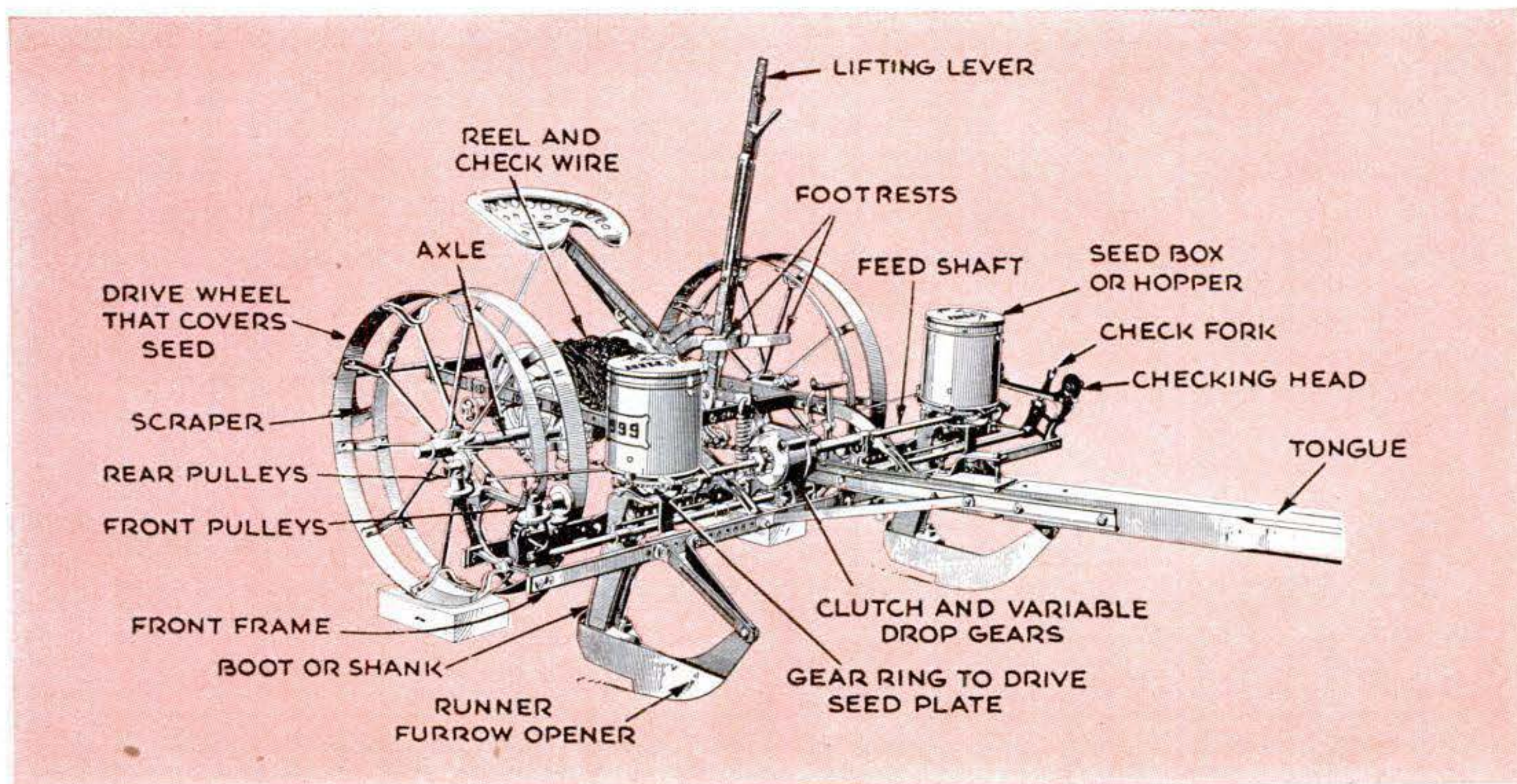
freely. Remove the wheels and make sure that all bearings are clean and well lubricated. Where the feed mechanism is driven through pawls, these should be checked for wear, and the pawl springs should be replaced if weak. It may be necessary to remove the feed shaft and replace loose or worn bearings. See that the feed shaft turns easily and does not bind because of rust or improper alignment.

Carefully test the drop mechanism, and the check head if it is a check planter, replace worn parts, and lubricate all moving parts. Oil the shaft in the feed boot on which the valves pivot.

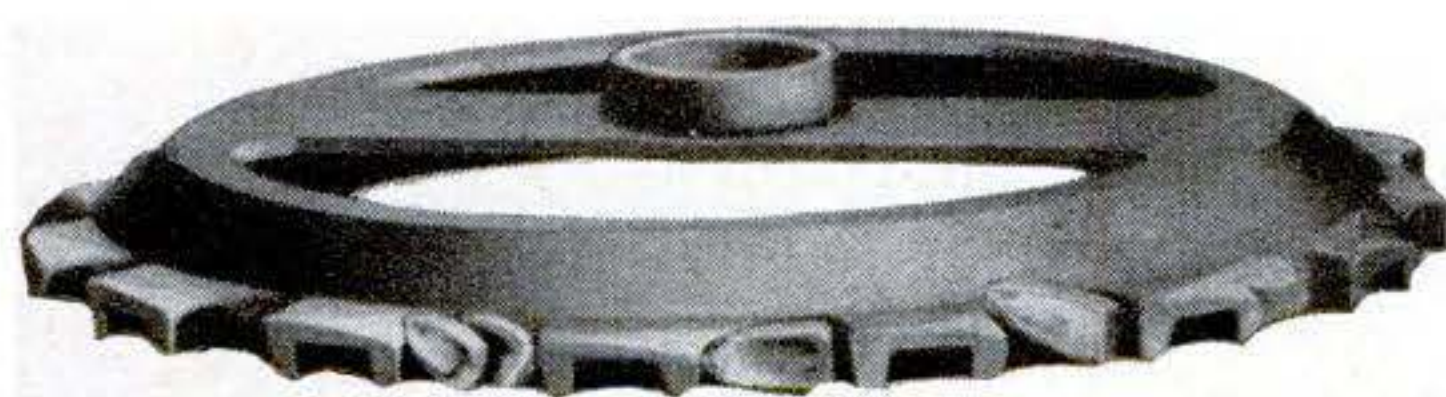
To secure uniform depth in planting, it is essential that the furrow openers be in good condition, and that each furrow opener be tested for loose connections either at the dragbar or at the frame of the machine. Dull furrow openers should be sharpened.

Where disk furrow openers are loose, new bearings should be installed to eliminate uneven planting. Check pressure springs and levers to see that they function properly. See that all bolts are tightened.

Before testing a corn planter, decide upon the amount of seed to plant. Highly fertile soil may take three kernels to the hill; less fertile, only two kernels. When the amount of seed to be planted is determined, the planter should be tested for accuracy of drop. The success of the test will be largely dependent on the seed plates selected to fit the size and shape of the kernels. Most farmers now use hybrid seed corn, and when it is carefully graded so that the kernels are of uniform size and shape, a proper plate for such seed can be selected. In planting, as the plate revolves, one kernel falls into each cell in the seed plate. Special plates may be obtained for planting round-butt



Above, the principal parts of a typical two-row corn planter. The kernels in the picture below illustrate why the plate cells must fit the seed. At right, the seed plate revolving at the base of the hopper selects the number of kernels per hill



kernels, small-tip kernels, large, flat kernels, and small sweet-corn seed.

The rate of planting is determined by setting a lever to accumulate two, three, or four kernels to be dropped in each hill, depending upon fertility. Some planters are built so the change of the number of kernels per hill can be made without stopping the planter. With two valves in the planter boot, one hill of seed accumulates on the upper valve as the hill on the lower valve, close to the ground, waits to be discharged.

To check the accuracy of drop, support the planter on blocks so the drive wheel will be free to turn. Trip the check head while turning the drive wheel and note the number of kernels that are dropped each time it is tripped. The accuracy may be as high as 90 per cent, depending on how well the seed is graded as to size, thickness, and shape of the individual kernels.

Proper adjustment of the height of the

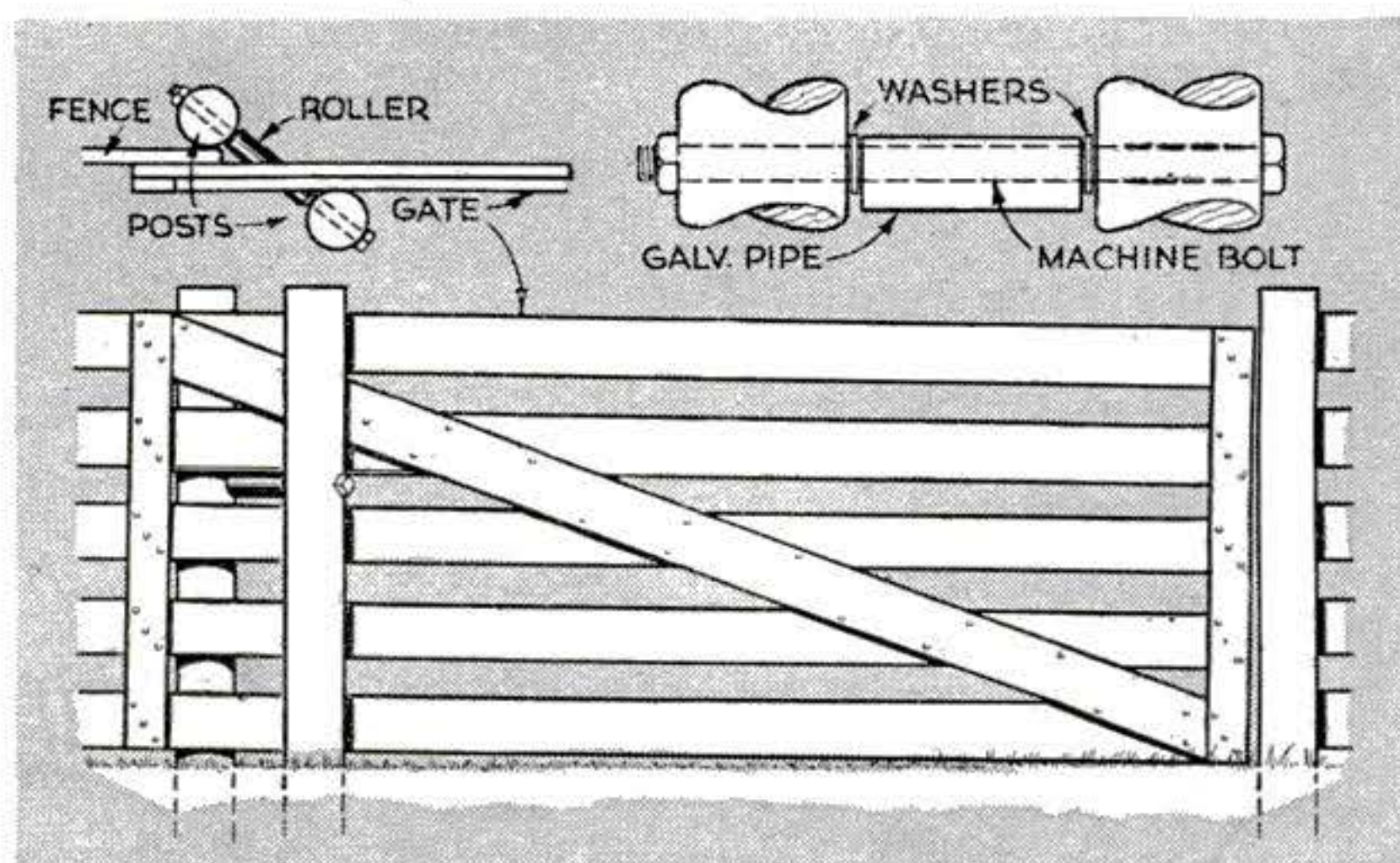
front of the planter is important for accurate checking. If it is too low, the kernels will be dropped a few inches back of the button on the check wire. Raising the front will throw the furrow openers forward and cause the kernels to be carried further before being dropped. Accuracy of checking can be determined by digging up a few hills in the field, marking them with small stakes, and sighting across the stakes.

Actual planting is achieved by the pressure of a heavy spring which causes the opener to penetrate the soil. The depth can be controlled by means of a lever that raises and lowers the furrow openers.

Check planters can be used for drilling corn by setting the planter to give the desired interval between kernels. This can be done by selecting proper seed plates or by changing sprockets. For drilling, lock the valves open with the foot lever, and lower the furrow openers.

Pipe Rollers Ease Opening of Hingeless Field Gates

A FIELD gate of the hingeless variety may be opened and closed with less exertion if a pipe roller is installed in place of the piece of wood ordinarily used to hold it up between its two posts. Mount a length of pipe on a rod bolted between the posts at a point where the second board from the top of the gate will ride upon it. Grease the roller for easy sliding.—J. K. K.



FEBRUARY CHECK LIST

[SHIPSHAPE HOME]

1. Overhaul poorly aligned door locks and bolts, and readjust hinges on doors that don't shut properly.
2. Clean snow from cellar windows to keep thawing from causing leakage.
3. Tighten bolts on kitchen range, replace missing ones, and adjust the burners.
4. Chisel out and plaster up all cracks in walls and ceilings.
5. Clean out gaps between kitchen fixtures and wall, and apply molding.
6. Remove loose floor tiles and reset in cement or a compound.
7. Scrape out loose filling around bathtub and calk with a waterproof compound.
8. Replace washers and packing in dripping faucets.
9. Fill and calk all crevices between the wall and floors.
10. Inspect first-floor joists and renail loose bridging.

POPULAR SCIENCE MONTHLY SHOP DATA



On every fighting front

Fisher

The Army-Navy "E" flies above four Fisher plants for excellence in aircraft production and from two others for tank production, while the Navy "E," with four stars, is flown by still another Fisher plant for its naval ordnance work.

THE men who do the fighting, whether on land, sea or in the air, know how important it is to have the best equipment.

They realize that the work we do in our factories can, if done well enough, give them a combat advantage.

We realize that, too. That's why we are devoting all the skills we have developed, all the crafts we have mastered, to give our armed forces the all-important edge.

Whether it's a plane, an anti-aircraft gun, a tank, or a highly sensitive flying instrument, each gets every technical plus we can give it — and that's several.

Craftsmanship is a Fisher tradition. And today we believe craftsmanship carries a particular punch of its own to give a fighting man a break when a break is more than welcome.

. . .

Every Sunday Afternoon
GENERAL MOTORS SYMPHONY OF THE AIR
NBC Network



armament
BOY BY

Fisher

D I V I S I O N O F G E N E R A L M O T O R S



Remember when . . .

you could buy new tires whenever you pleased?

IT DIDN'T MATTER so very much then if a tire's pressure was a little lower than it should have been.

We didn't worry a great deal if we stopped shorter than we should, and left a few rubber marks on the pavement.

There was nothing terribly wrong about gouging off a little of the tread in showing how fast we could get away from a stop-light.

And, as long as we chose the right time and place, it was no crime to "burn up the road" occasionally for the sheer joy of fast motion.

It's different now—and how!

Every car in use today is a national asset; it must be kept rolling. And every ounce of rubber in its tires is part of our wartime resources—to be cared for, protected against abuse, made to last as long as possible.

That's the reason for frequent tire inspections

—Victory Speed—slow starts and stops—properly maintained tire pressures—careful parking to avoid sidewall damage—and all the other tire-saving precautions you can take.

By doing these vitally important things—not just *some* of them but *all* of them—every American car owner can help in a very real way to make victory more certain and more complete.

★ ★ ★

REMEMBER WHEN your Seiberling Dealer was able to offer you all the brand new tires you wanted? He can't be liberal with tires today, but he can and does come through with the personal service and personal interest you can get only from an INDEPENDENT business man. We at Seiberling believe in the dynamic, creative force of American independence—independence of thought and action, and INDEPENDENCE IN BUSINESS. That is why Seiberling Tires will continue to be sold, as they have been for a generation past, by INDEPENDENT dealers only.

SEIBERLING Experts in Rubber

Wartime manufacturers of Bullet-Sealed Tubes and Military Tires for our armed forces • Bullet-Sealing Gasoline Tanks • Rubber Floats, Boats and Pontons • Rubber Parts for Gas Masks, Airplanes and Tanks. Also makers of Tires and Tubes for passenger cars and trucks • Sealed Air Tubes • Rubber Heels, Soles and Mechanical Goods.



Making Our Soldiers Tough *(Continued from page 60)*

at regular intervals. This determines his muscular strength, agility, endurance, and co-ordination. It's also a sure way to find out the extent of his improvement under training.

Creators of the program simplified the routines to make every movement an effective training device. They gave each exercise in the now famous dozen a name that soldiers can easily remember; they stipulated an exact number of counts, so that motions can be made in cadence and whole drills run off with a minimum of commands.

They named their 12 the high jumper, burpee, squat bender, rowing exercise, push-ups, sit-ups, side bender, bank twist, squat jump, trunk twister, stationary run, and eight-count push-ups. Later, they adopted some alternative exercises, known as the mountain climber, the wood-chopper, and the bridge. Most of these names are descriptive of the motions.

In the high jumper, for instance, the men swing their arms from their sides to above their heads and jump straight up, at least a foot into the air. Then they swing their arms forward and jump in that position, then backward and jump. This is done in rapid cadence, from 12 to 25 times before the men pass on to another exercise at a single command, and without any intervening rest.

Besides the calisthenics, there are drills in which men of approximately the same weight and height may be pitted against each other, individually or in teams. The very names of these describe what they do. They are the hand wrestle, the pull-hands, the wrist bend (or make-'em-beg), the head push, the shoulder push, the back-to-back push, the knock-'em-down, and others.

In the knock-'em-down, for instance, each of two men tries to knock his opponent off his feet in any way possible. Each contestant may tackle, push, pull, lift, or wrestle. The first man who has any part of his body except his feet touching the ground loses.

In developing these exercises, the authors of T.C. 87 did not forget that marching under full field equipment and playing such games as soccer, baseball, pushball, and volleyball are valuable aids to training. They set up some rigorous standards for marching under full pack. Here are some of them:

"March four miles in 45 minutes; march five miles in an hour; march 16 miles in four hours; march 25 miles in eight hours;

march and double-time for seven miles without halt."

Once they were convinced they had worked out an improvement on old Army methods, the physical-education experts made a demonstration test at a camp in California. They took two companies of 250 men each, so equated that each had the same number of men from various sections of the country, from various walks of life, and of various ages. As nearly as possible, these two companies started equal in physical condition. Each underwent a six weeks' training course, under constant observation; the experimental group with the new system of physical toughening, and the control group with the traditional.

At the start and at the close of this period, every man in both companies received a test in eight exercises. There were pull-ups, push-ups, sit-ups, and three successive standing broad jumps to test their strength. There was the 20-second burpee to test their agility. To test their endurance, each was required to run 75 yards with a man of equal weight on his back, and 300 yards as a sprint. To test their co-ordination, each was put through a dodging run about obstacles. The improvement of each company was measured on a point system. It showed that the experimental group had gained by 23.5 percent, while the control group, under former Army methods, had improved only 3.5 percent.

The average man in the experimental company increased the number of times he could chin himself from 8.3 to 10.8 times. His push-ups increased from 20.4 to 32.2 times. He cut his time for running 300 yards from 51.2 to 47.5 seconds.

Since that test, the Special Service Forces have been gradually installing their system of physical drill and periodic testing throughout the Army, as officers are trained to conduct it. They have worked out some average physical-capacity standards for soldiers according to seven tests, and a point system whereby every soldier can see where he stands in comparison with his fellows. The job of the athletic officers includes stimulating individual soldiers to improve their ratings.

Three periods of training change the raw recruit into a toughened soldier. The first, of six weeks, emphasizes calisthenics. These gradually give way during the second period—from six to 10 weeks—to competitive games. Thereafter is a period of "maintenance of condition."

PLUGS FOR THE TRUCKS OF CHINA



WHEN you learn of fresh action on the China front, you can be sure that motor trucks from the U. S. A. are "in there—pitching." And, they *must get through*.

Thousands of the trucks are equipped with the same make of spark plugs, oil filters, and fuel pumps which has served America so well, so long. They wear the AC emblem, which is known as a symbol of good engineering, trustworthy performance, and precision manufacturing.

Conservation HERE Means Victory Over THERE

In order that military vehicles, planes, and ships may have all the AC Spark Plugs, Oil Filters, and other products needed, we here at home, cannot have as many.

Let your repair man conserve your transportation by keeping your AC devices in condition. When replacement is necessary, select AC—for continued satisfaction.

AC SPARK PLUG DIVISION
GENERAL MOTORS CORPORATION

BUY WAR BONDS—AND BRING VICTORY QUICKER



United Nations Flag Quiz

How well do you know the flags of our allies? In each of the statements below, only one of the choices given is correct. Check your results with the answers below. If you do *too* badly, better go back and study up on pages 92 and 93.

1. Six stars appear in the flag of (a) Honduras (b) Australia (c) New Zealand.
2. Color found in the greatest number of flags is (a) red (b) white (c) blue.
3. Named on its flag is (a) Mexico (b) Iran (c) Nicaragua.
4. The globe appears on the flag of (a) Poland (b) Brazil (c) South Africa.
5. Green is predominant in the flag of (a) Mexico (b) Haiti (c) Costa Rica.
6. A white cross is the symbol of (a) Yugoslavia (b) Luxembourg (c) Greece.
7. Written words are on the flag of (a) Canada (b) Czechoslovakia (c) Brazil.
8. The sun shines from the flag of (a) India (b) Australia (c) Norway.
9. Fleur-de-lis of France appears on the flag of (a) Luxembourg (b) Belgium (c) Canada.
10. Three horizontal bars, red, white, and blue, make up the flag of (a) Ethiopia (b) Netherlands (c) Panama.
11. A bird is found on the flag of (a) Panama (b) Iraq (c) Poland.
12. There's a lion on the flag of (a) Australia (b) Iran (c) India.

ANSWERS

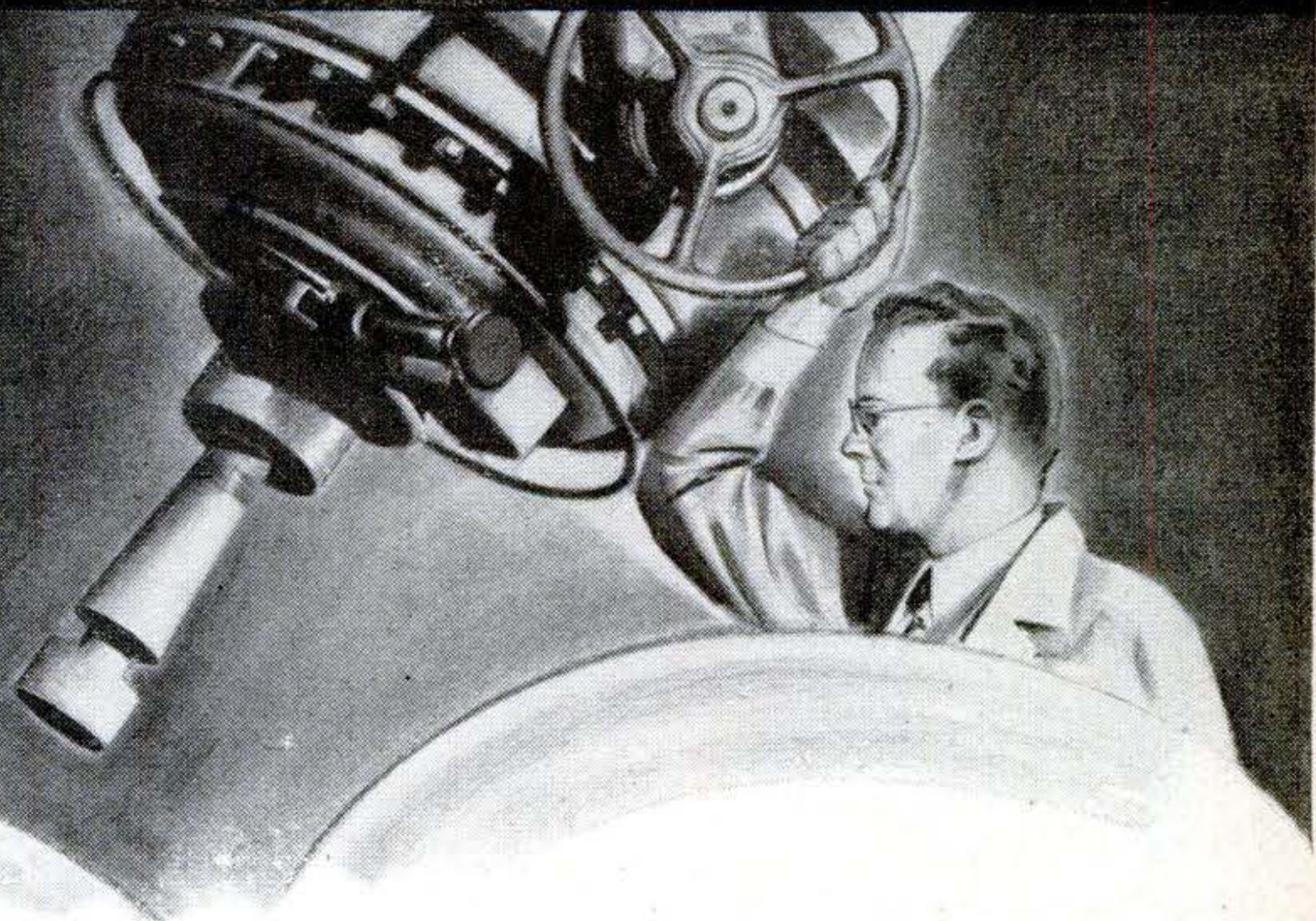
- | | | | | | |
|------|------|------|------|-------|-------|
| 2. b | 4. b | 6. c | 8. a | 10. b | 12. b |
| 1. b | 3. c | 5. a | 7. c | 9. c | 11. c |

Home and Workshop Index for Your 1943 Issues

YOUR back copies of POPULAR SCIENCE will be more valuable, and the wealth of material in them will be readily at your finger tips, when you have a copy of the new Home and Workshop Index. It lists all articles that appeared from March 1943 through December 1943, on home repairing, chemistry, craftwork, model making, wood-working, radio, automobiles, and new shop ideas—alphabetically arranged and cross-indexed for convenience. Send a dime to Popular Science Home and Workshop Index, 353 Fourth Avenue, New York 10, N. Y., enclosing a stamped, self-addressed No. 10 (legal size) envelope. A limited number of 1942 indexes are also available; send 20 cents if you wish both.

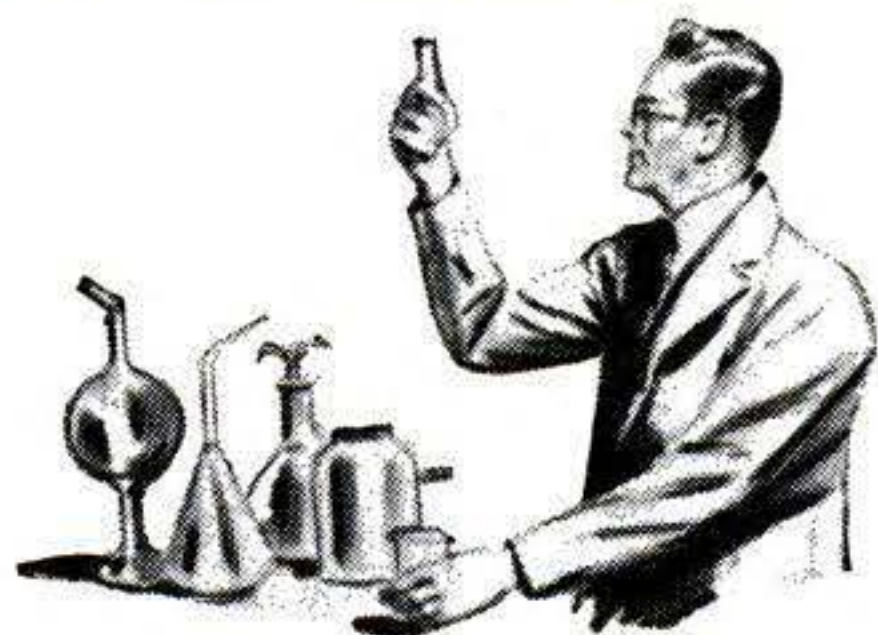
EVERLASTING TEAMWORK

The Story of Ernest E. Charlton



ERNEST CHARLTON wanted to become a banker. But today he's managing millions of volts instead of millions of dollars!

During his last year at Grinnell College, Iowa, the offer of a scholarship in chemistry at the University of Illinois changed his mind about banking. At Illinois he also studied physics and engineering, played semi-pro baseball, taught undergraduate classes—and came out with a Ph.D., a stack of Liberty bonds, and a job with a New Jersey chemical company.



Before long he was offered a position as chemist in General Electric's Research Laboratory. There he coaxed the rebellious metal caesium into the vacuum tube, helping to pave the way for development of photo-tubes for modern movies and television. His success in working with electron tubes led to his appointment in 1929 as head of the X-ray section.

And then the real fun began! He and his colleagues began developing tubes for higher and higher voltage X rays. One was the 1,000,000-volt Cyclops eye that sees through

inches of steel the way the human eye sees through glass. Then came the development of the newly-born "betatron," in which a 2,000,000-volt infant has grown first to 20,000,000 and now to 100,000,000 volts. With this growth it produced electrons of higher and higher energy and X rays of higher and higher frequency. What such radiations will accomplish no one yet knows—but then, Dr. Charlton believes, that's the fun of research!

He also believes that the problems of research are solved not so much by individual effort as by the everlasting teamwork of the scientists. Learning through failures, trying again and again until you get the solution—that means success not only in research, but in life.

A golfer of tournament status, Dr. Charlton is now too busy with secret war work to cover the links except sometimes on Sunday morning. But he's one of the players in the All-America game of beating the Axis! *General Electric Company, Schenectady, N. Y.*



Hear the General Electric radio programs: "The G-E All-girl Orchestra" Sunday, 10 p.m. EWT, NBC—"The World Today" news, every weekday, 6:45 p.m. EWT, CBS.

192,000 employees of General Electric are buying over a million dollars of War Bonds every week.

GENERAL ELECTRIC

958-27E-211

POWDERED METAL *helps* ... *and* SPEEDS



**FROM POWDER
TO GUN PART IN
22 Seconds!
(200 TIMES FASTER)**

From metal powder so fluffy that a good puff of breath will blow it away, Chrysler Corporation is today turning out parts of most intricate shapes to precise measurements. Some of them are actually so tough that they will even cut glass.

Back in the late twenties Chrysler Corporation Engineers developed and its Amplex Division began to produce heavy duty oil-cushioned bronze bearings. The experience gained in this interesting and economical way of manufacturing is now saving precious time, strategic metals and releasing machine tools and men for other war work.

Chrysler Corporation produces hundreds of thousands of powdered metal parts every month for the Nation's superior weapons of war.

WAR BONDS ARE YOUR
PERSONAL INVESTMENT
IN VICTORY

CHRYSLER

AMPLEX • PLYMOUTH • DODGE

build SUPERIOR WEAPONS

WAR PRODUCTION



Powdered Metal Parts Save Both Metal and Man Hours

This anti-aircraft cannon uses 106 different, solid or oil-impregnated parts made from powdered metal. Over a 12-month period, the use of

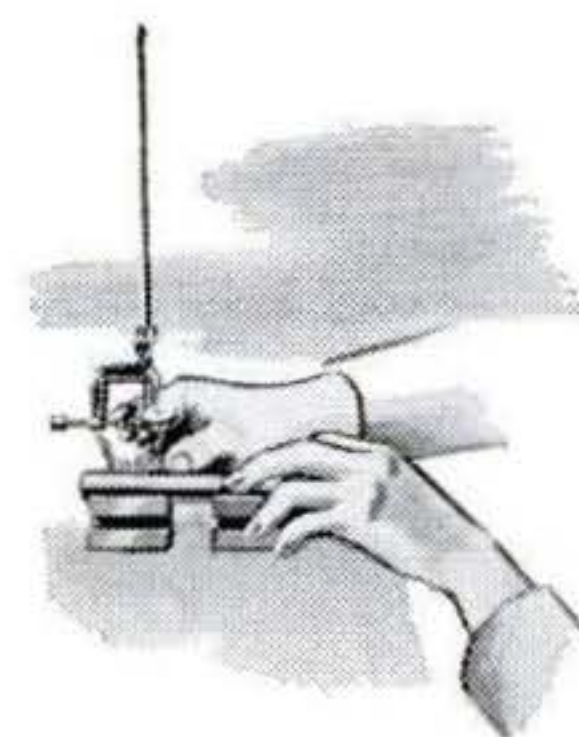
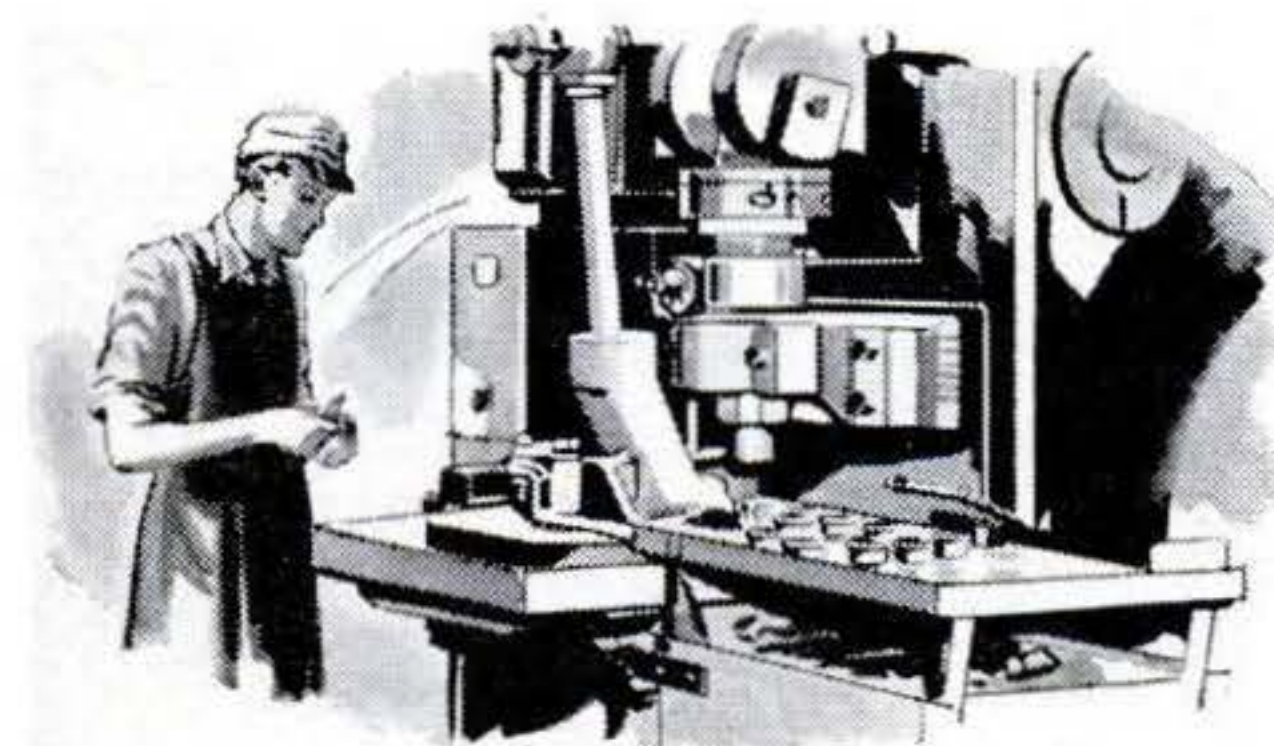
powdered metal parts on this weapon instead of originally designed solid metal parts, alone released 8,000,000 man hours and 1,250,000 pounds of metal for other war tasks. As an example of metal saving, a 20-pound part requires only 20 pounds of powdered metal; whereas, in standard manufacturing practice, losses in machining sometimes range from 20 to 75 per cent.



Oilite Solves Many Lubrication Problems

Self-lubricating Oilite bearings in engines and controls, help fast climbing aircraft get

"upstairs" in a hurry. Functional problems caused by quick and extreme temperature changes from ground level to high altitudes are often solved through the use of countless Oilite bearings which are practically "fool-proof" in operation. Some bombers contain more than 2,000 powdered metal parts made by Chrysler Corporation.



New and Fine Degrees of Precision are now Attained

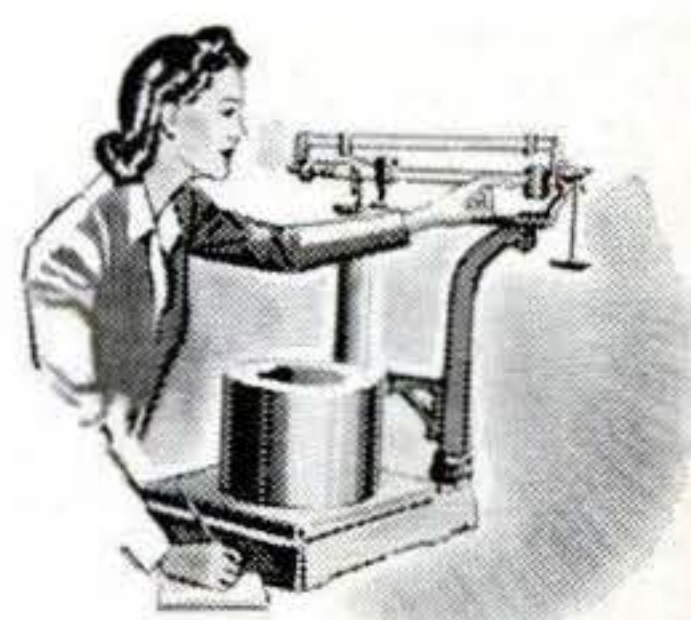
Chrysler Corporation produces, in quantity, micrometer frames, tool makers' vee blocks harder than glass, gauge units and other instruments capable of accuracy greater than one ten-thousandths (0.0001") of an inch.

Making such precision instruments was formerly a slow, painstaking task. Now they are "pressed out" in a matter of seconds, 75 per cent complete.

Big Parts Developed for War Machines

Engineers, metallurgists and powdered metal production men of Chrysler Corporation have definitely disproved the belief that some large and

heavy parts could not be made from powdered metal. Where a part weighing three pounds was a pre-war maximum, Oilite bearings twenty times this size are now being made.



From Peacetime Research Have Come Developments that Solve Many War Production Problems

Remember the days when you could first forget about oiling the vacuum cleaner or refrigerator or the clutch bearings on your automobile? This was only the starting phase of great development in the field of powdered metal manufacturing. In its production of many thousands of different war weapon parts, Chrysler Corporation, a pioneer of *heavy duty* and *large* powdered metal units, has brought a fast, economical metal-and-manpower-saving means of manufacture to major war industries.

Tune in Major Bowes every Thursday, CBS, 9 P. M., E. W. T.

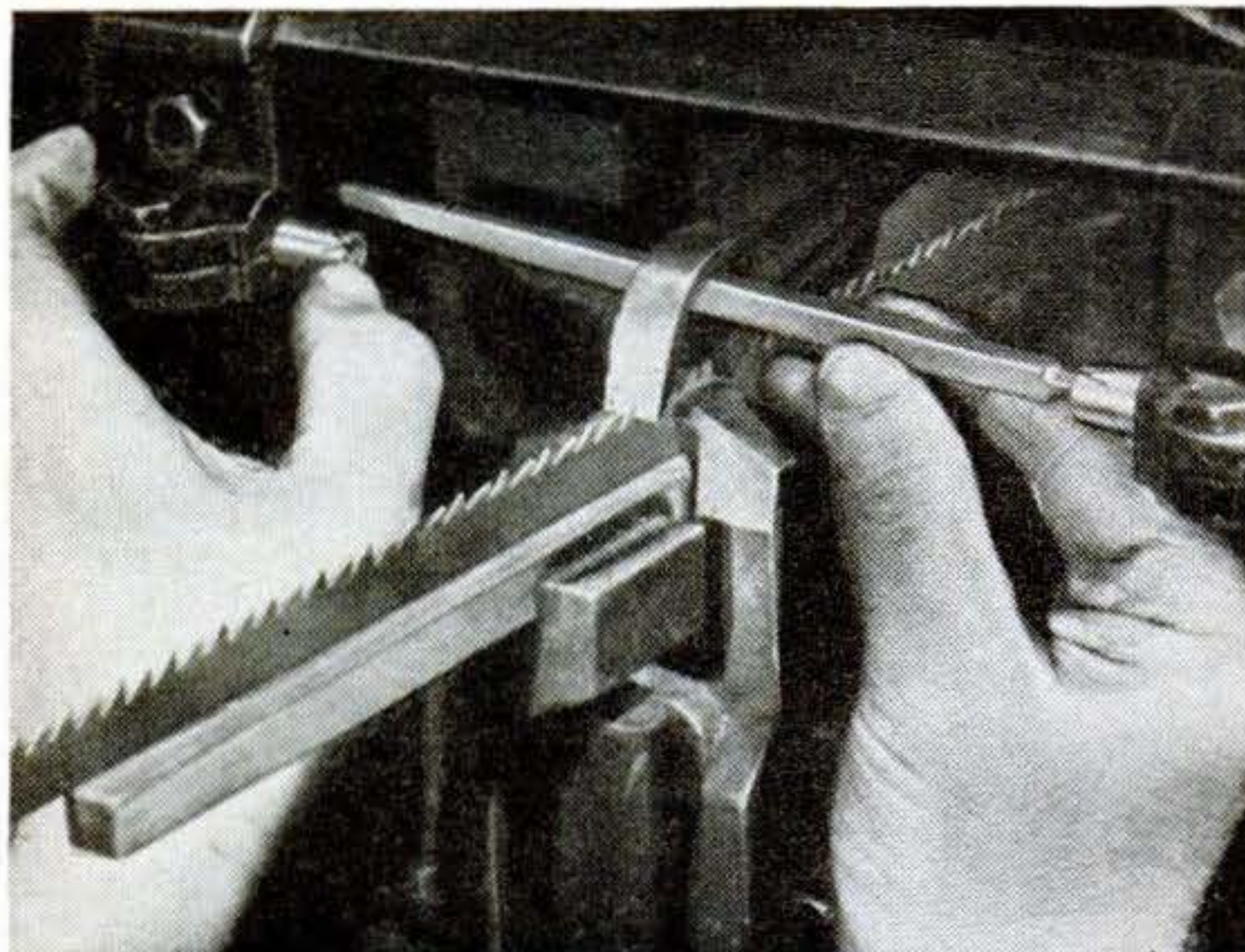
CORPORATION

DE SOTO • CHRYSLER • AIRTEMP

SPEED MACHINE SAW FILING

with Nicholson File Holders

(POINT AND TANG HOLDERS)



They simplify rotating, removing, replacing and positioning of file.

NICHOLSON File Holders for repetitive filing are a great improvement over methods which involve infinite making and undoing of adjustments. No hand-and-hammer wedging of file into holders! No "unwedging" or loosening of set screws to turn or remove file! No repeated hand gauging! Note this simple, methodical procedure:

INSERTING FILE. Push back spring plunger of point holder. Insert tang. Triangular socket engages file at precision-formed surface, not at less accurately forged tang. Insert point; release plunger. Position file; tighten set screws. Once does it—for entire job.

TURNING FILE. Push file forward to disengage shoulder end. Rotate file for fresh cutting edge. Release plunger; file springs back. All set to go again!

HOLDERS available for every size triangular file. COMBINATION BRACKETS to fit all standard saw-filing machines—Anderson, Cleveland, Foley, Seigmeister, Wardwell, etc. Consult any mill-supply house handling Nicholson or Black Diamond Files—or write us direct.

Nicholson File Co., 19 Acorn St., Providence 1, R. I., U. S. A.
(Also Canadian Plant, Port Hope, Ontario)

NICHOLSON
FILES FOR EVERY PURPOSE
NICHOLSON
U.S.A.
MADE IN U.S.A.

I Fly "Mitchells"

(Continued from page 73)

make co-ordinated 15-degree turns, right and left. I'll bet gunners on the ground developed some Nazi version of the jitters, trying to cut their fuses accurately and guess what we'd do next. They couldn't figure both range and deflection accurately while we were galloping like wild colts across the sky.

At first we carried small, close-cover fighter escorts, usually six P-38 Lightnings. They hovered 1,000 feet above us like eagles, ready to beat off the hawks. As our flights grew larger, until 100 or more mediums would set off in formation, protected by half a hundred Lightnings, we revised our tactics. You can't hide large numbers of bombers from an alert enemy during day-time sweeps. When large masses of bombers take off, they often rendezvous at bombing altitude above their own field and set out on course for the target. When in enemy territory, we took slight evasive action, weaving and changing altitude en masse. For 30 seconds we would fly level, drop our stuff, climb sharply to throw the gunners off, dive to 5,000 (picking up an extra precious 40 miles an hour), and high-tail for home.

For a time after losing *Miss Mary Jane*, I piloted *Cordelia's Bob* (Cordelia being my mother's name). Her hydraulic and electrical systems shot out and the right rudder gone, she washed out in a crash landing at Telergma one day. That's not a very exciting tale, but *Cunningham's Coffin*, my third Mitchell, came within an ace of living up to the name I bestowed upon her.

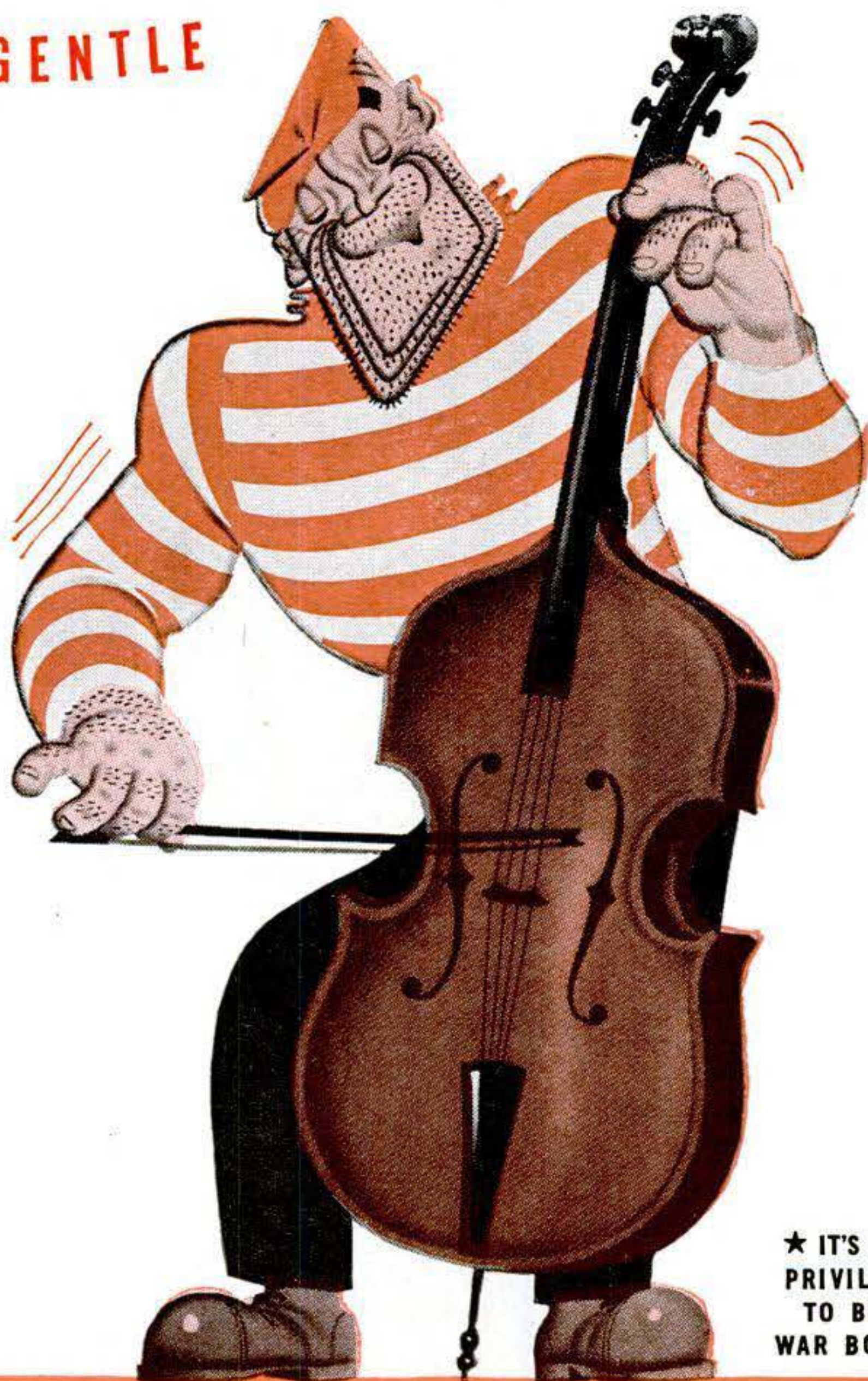
May ended the African campaign, but the Kasserine Pass break-through had not developed when the high command called upon us to sweep the Mediterranean. Daily our planes would sweep Mussolini's *Mare Nostrum*, covering an 800-mile area between Sicily, Sardinia, and Tunisia. We flew usually in flights of 18, ready to take on German fighters or break into elements of three to attack individual ships in Africa-bound convoys. Large tankers and transports rated triple-A priority, and if possible we came down out of the sun to make sure they got it.

Rommel's supply corps strove desperately to get fuel and other materials to him, especially high-octane gasoline for his dwindling air force and tanks. One day while the Kasserine Pass battle raged, our Intelligence reported a tanker was due to leave Sicily shortly, bearing 1,000,000 gallons of gas. Briefing had scarcely begun when we knew this was a "must get" deal.

(Continued on page 210)

TOUGH... BUT OH SO GENTLE

Keep it Sweet!



★ IT'S A
PRIVILEGE
TO BUY
WAR BONDS

★ A sweet running car is music to the ears. It means the motor is operating efficiently; that it will last for a long, long time. That's mighty important these days when a breakdown may leave you without a car, indefinitely.

It's simple to keep your motor running *sweet* when you watch it carefully and

get it to your motor service man—before it goes *sour*.

At the first sign of ring failure, have him install a set of Hastings Steel-Vent piston rings. They stop oil-pumping, check cylinder wear, and restore gasoline economy.

HASTINGS MANUFACTURING COMPANY, HASTINGS, MICH.
Hastings Mfg. of Canada, Ltd., Toronto

HASTINGS

U. S. PAT. 2,148,997

STEEL-VENT

*Tough on oil-pumping
Gentle on cylinder walls*

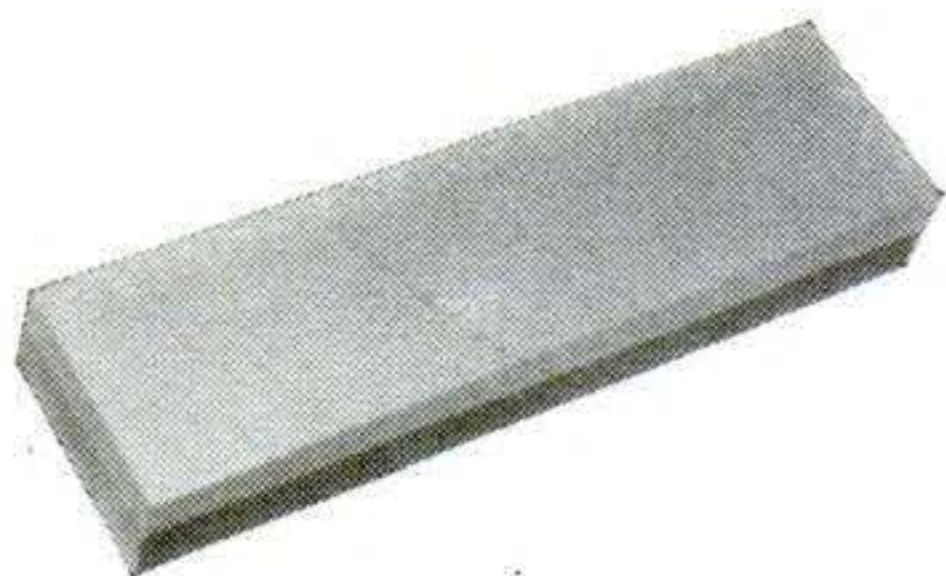
PISTON RINGS

FEBRUARY, 1944

Buy War Savings Bonds and Stamps regularly.

209

HOW TO KEEP TOOLS SHARP



1. USE THIS STONE!

A Carborundum Brand Silicon Carbide Combination Sharpening Stone gives tools the edge that results in better work. It'll also help make your tools last! One side is of coarse grit for dull tools. The other is of very fine grit for that smooth, keen, fast-working finished edge. Ask your dealer for Carborundum Brand Silicon Carbide Sharpening Stone No. 109.



2. WRITE FOR FREE BOOK!

A lot of us realize the importance of sharp tools for good work. But many don't know how to go about it. If you want to know the best ways to sharpen planes, chisels, draw knives, etc., write today for your free copy of "Short Cuts To Better Work For The Home Craftsman." It's full of practical, tested methods of sharpening home workshop tools.

CARBORUNDUM

ABRASIVE PRODUCTS

Dept. S-24

THE CARBORUNDUM COMPANY

REG. U. S. PAT. OFF.

Niagara Falls, N. Y.

(Carborundum is a registered trade-mark of and indicates manufacture by The Carborundum Company)

I Fly "Mitchells"

(Continued from page 208)

We swept out in three-plane elements, scouting widely south and east of Sicily. At 4:30 in the afternoon, immediately off the Sicilian coast, Art Canham, flying the lead plane of my flight, wagged his wings, signaling a suspicious movement somewhere on the horizon. Soon Art dipped sharply to the right, sending Morry Miljius off to paste a light cruiser, while Art and I took on the tanker. We ignored three destroyers, now opening with all their AA guns in a desperate effort to drive us away.

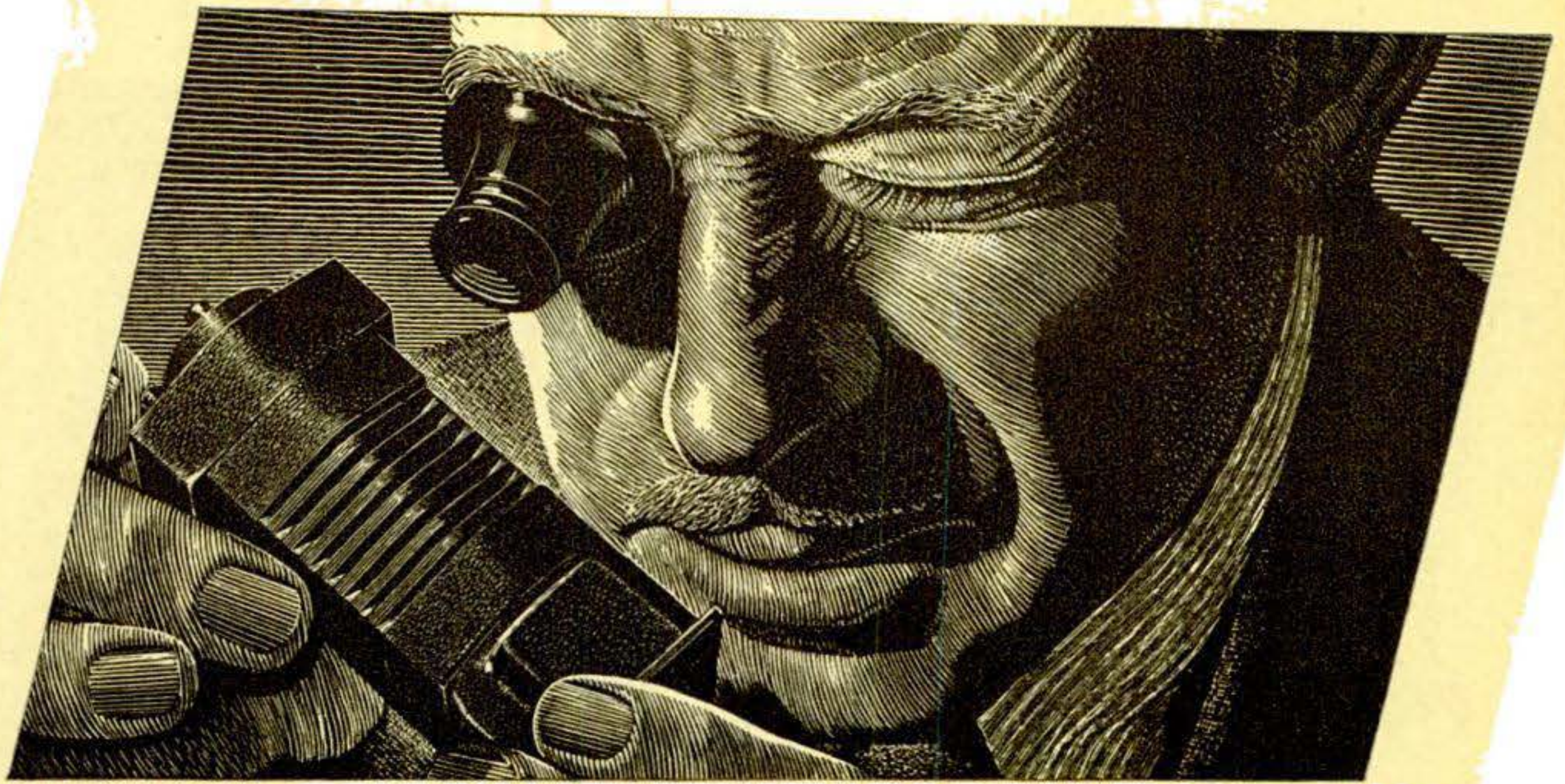
Art and I dived from our searching altitude, 500 feet, to 10 feet, picking up speed to help carry us more quickly through the streaming flak. Luckily, the sun was exactly behind us, and we rolled in for a three-quarter angle of attack. I had no time to be thankful then for the low ceilings down Burma way that led to the development of skip bombing. I felt certain one of us would get that wallowing tub, unless they got us during the next few seconds, needed for the last two miles of approach.

Red-hot rivets were pounding us in the face now, splattering into the engines, wings, and fuselage. To escape them, we took violent evasive action, flying now wing tip to wing tip, again spreading out, skidding in and out, diving and zooming. About three city blocks from the tanker, we came together for the final run and 500 feet out from that inflammable cargo turned loose three 500-pound bombs each. One of mine skipped, struck the near side, and exploded below the water line; the second smacked into the deck, where it gutted the vessel amidships, firing her precious cargo. The third fell harmlessly over. One of Art's smashed into the deck, and two carried over, one close enough to spring the plates. She was perfectly bracketed! That night the gas was still flaming, giving our boys a nocturnal check point as they roared by to bomb Sicily.

Cunningham's Coffin? Not this time. Not quite, though the Mitchell almost carried me to a Davy Jones grave. We were a quarter mile distant when the bombs, carrying four-second-delay fuses, went off. In this incredibly short time, I learned that we were in serious trouble. Flak had shot out my port engine—and, to make matters desperate, its feathering mechanism as well. Other blows from 20-mm. explosives had torn out the gas tank, which now was hanging and flooding gasoline. "One spark," I remember thinking, "and we're goners." I glanced

(Continued on page 214)

Who can use this after the war?



SO far this is definitely a war baby. It was born to meet an exacting wartime need. Every one that is made goes right into the fight.

It is an electric motor designed for jobs which no regular electric motor could fill.

The jobs are on America's fighting planes. Working control flaps—opening and closing cooling shutters—lifting landing gears—and the like.

Every ounce on an airplane is precious. So usual electric motors were out.

This one weighs as little as 8-tenths of a pound—others can move as much as 35 tons.

Naturally it took a whole new

kind of engineering to make this motor.

It took new ideas from the drawing board up. It took new materials—like glass-insulated wire—to build it. It required finer, more precise craftsmanship than had ever gone into a motor before.

After the war, these motors can be sold to manufacturers of peacetime products.

That is why we are telling you about them now.

You may have need for such a compact, ultra-efficient source of power. You may be able to use the kind of engineering thinking that developed it—or the production technique that builds it and about 250 other Lear Products.

PLANTS: Piqua, O., and Grand Rapids, Mich. BRANCHES AT: New York, Los Angeles, Chicago, Detroit, Cleveland, Providence.



There's been
a
big change



JUST as the rhumba replaced the polka, "cageless" roller bearings have found their place in the more exacting world of today.

Tyson's "All-Rolls" design startled bearing manufacturers. "It can't be done," they declared . . . But Tyson

did it—perfected a tapered roller bearing with *thirty percent more rollers*.

And with these extra rollers, Tyson established a new maximum in bearing efficiency—greater load-capacity, more strength and rigidity, longer life. *The big name in bearings today is...TYSON!*



TYSON BEARING CORPORATION, MASSILLON, OHIO

COUNT THE ROLLS • THE ROLLS COUNT

Tyson

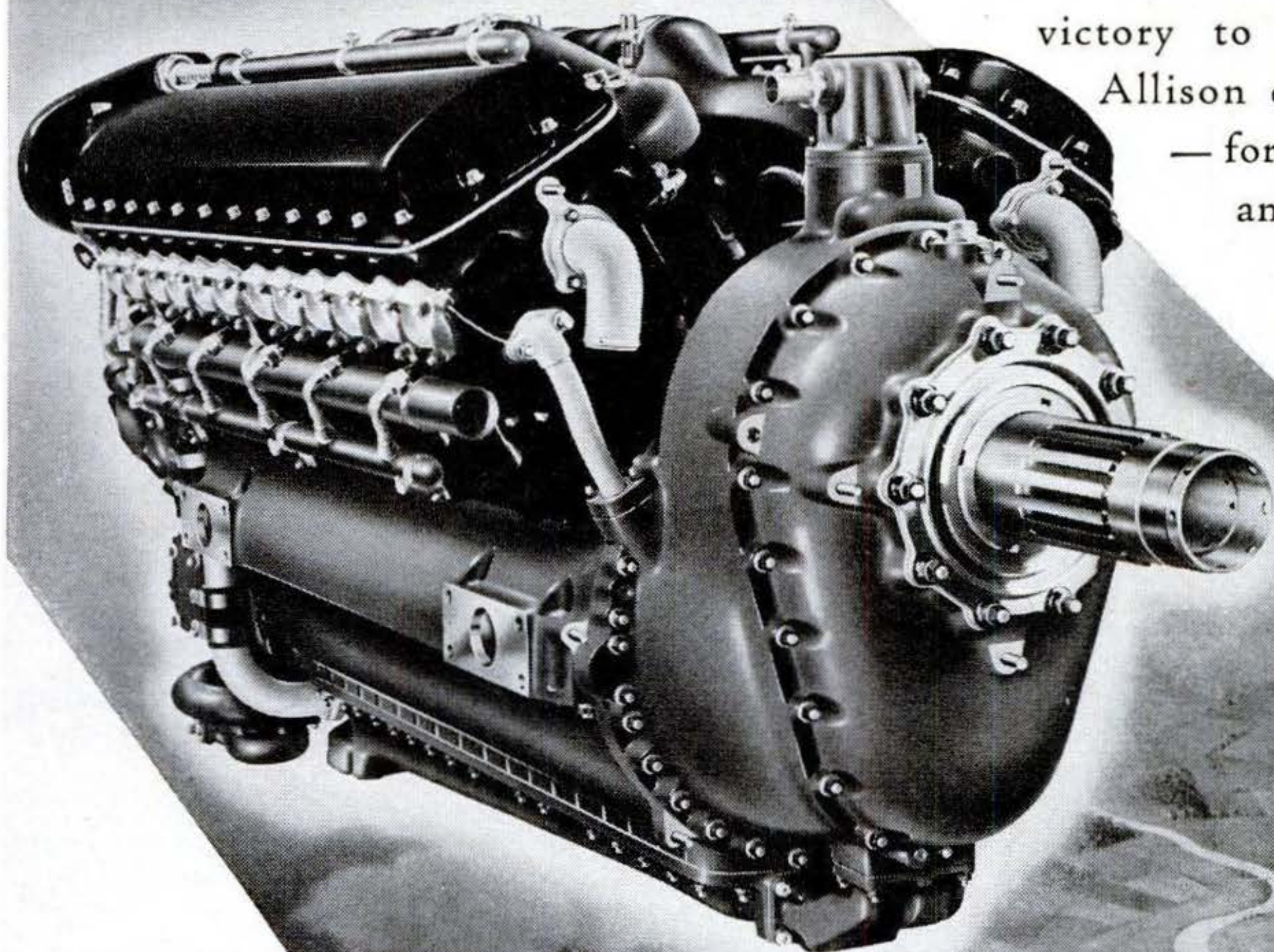
TODAY'S HEAVY-DUTY BEARING



★ BUY MORE WAR BONDS ★

THE ENGINE THAT IS ALWAYS THERE

Allison-powered planes have been called upon in every major engagement in which our Army has taken part. ★ They have had a hand in every great land victory to our credit. ★ Allison engines always — for dependability and brilliant performance!

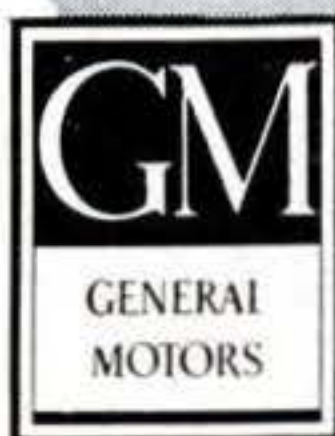


Every Sunday Afternoon
GENERAL MOTORS SYMPHONY
OF THE AIR—NBC Network

LIQUID-COOLED AIRCRAFT ENGINES

Allison

DIVISION OF



POWERED BY ALLISON:

P-38—Lightning • P-39—Airacobra
P-40—Warhawk • A-36 and P-51—Mustang

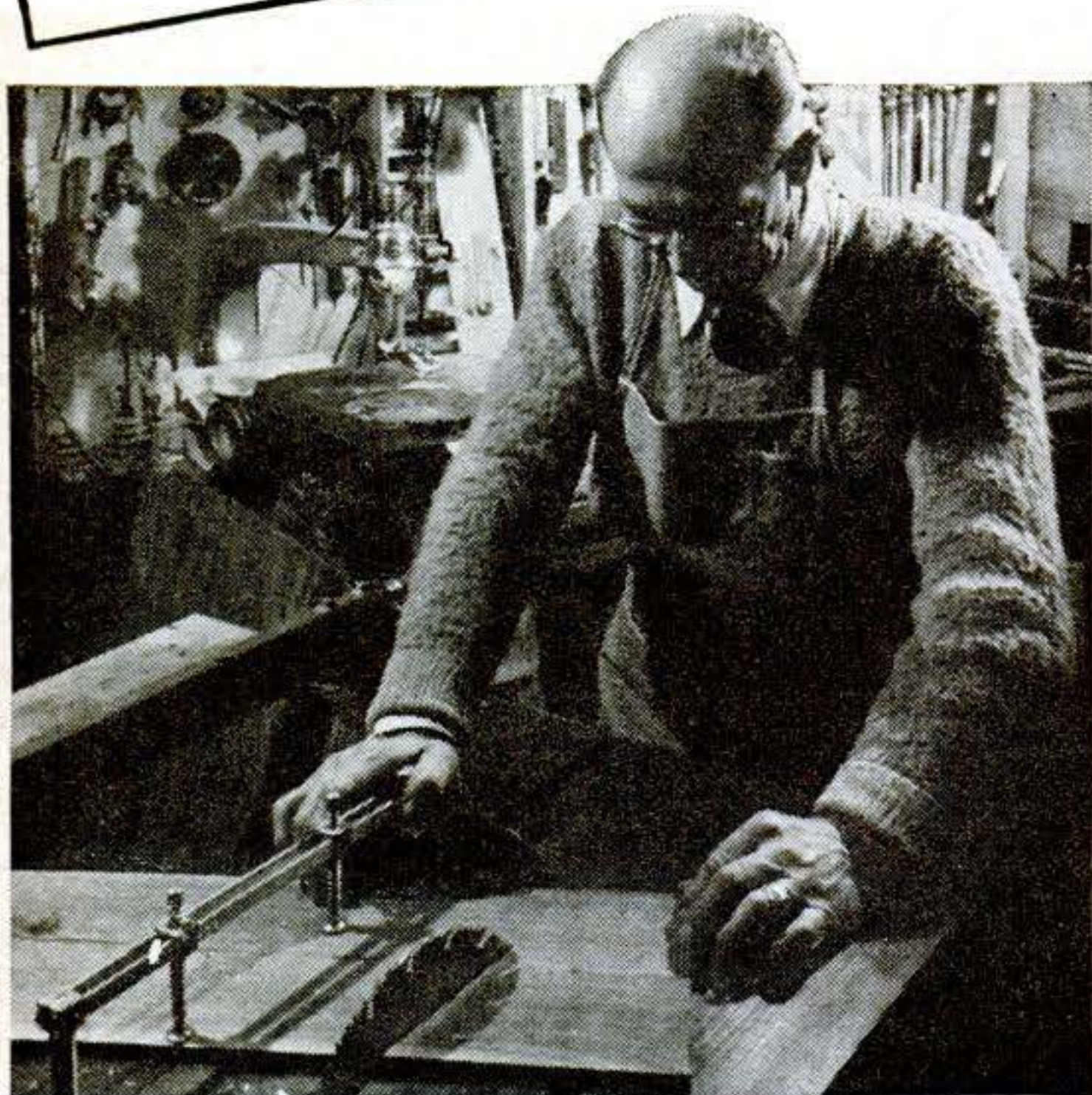
KEEP AMERICA STRONG
BUY MORE WAR BONDS

FEBRUARY, 1944

Buy War Savings Bonds and Stamps regularly.

213

When You Need a New Saw . . .



ASK FOR AN ATKINS FIRST!

▲ When you need a new saw, make it an Atkins . . . you will be getting a saw that will serve you for the duration and many years after.

That's because these Silver Steel Saws have keener, longer lasting cutting edges. Each saw is engineered for speed and accuracy on the kind of work for which it is intended. Ask your dealer if he can supply you with an Atkins.

Atkins "How To Do It" Book—Only 10c
Full of helpful hints on the use and care of Saws. Send for yours today.

E. C. ATKINS AND COMPANY
428 South Illinois St., Indianapolis 9, Indiana
Agents or Dealers in All Principal Cities The World Over



Silver Steel Saws

I Fly "Mitchells"

(Continued from page 210)

again at the dead prop. Friction had turned the hub red hot. Had I been able to feather the prop, we could have made our base easily on one engine. As matters stood, I had no choice. I set *Cunningham's Coffin* down on the smooth sea, 70 miles from home. Seventy seconds later she disappeared beneath the Mediterranean, and 36 hours later a rescue boat came along and picked us up.

More raids followed. I now flew my fourth Mitchell. Unwilling to give her a name for fear she might follow my first three into oblivion, I knew her by serial number only. We bombed Sicilian airdromes and dock installations and supported ground movements. Then came our participation in the first raid on Rome. Fortresses and Liberators touched off this show with a high-level precision attack on the two bottleneck railroad centers. Two waves of Mitchells followed 90 seconds later, striking the Littorio targets.

Rome was little more than another raid to me. Flak was inaccurate and weak. I shall remember forever my ride over those marshaling yards, for Rome was the last enemy city I was to look down upon. My last raid before coming home.

I checked my log when I landed that afternoon. Fifty-two missions . . . 165 combat hours. Except for a single leg wound (I was hit over Gabes), from which I already had recovered, I was sound as the proverbial dollar.

My mind went back to my Fortress tour of the Ruhr. That day, nearly a year earlier, I had said to myself:

"I'm responsible for the safety of a valuable airplane and four other men. The Army has trained me well. Now, have I got the guts to take them into combat and the skill to bring them out again with their lives?"

I looked across the apron at four men walking away from our last combat landing.

There went Lt. Gerry Upchurch, the "Old Sock" of the outfit and a good-enough bombardier for any air crew. Lt. Jay "Eight Ball" Colvin, the Houston, Tex., boy who had navigated us home from many long flights, ambled after him. Tech. Sgt. Frank Lockhart of Pittsburgh, Pa., our radio operator, and Staff Sgt. Elvin Davis, who lived in Tacoma, Wash., before climbing into our upper gun turret, trailed heavy-footed in the rear.

Our last combat! We had come through hell together.



"We are proud to pay tribute to the added efforts of our employees which have made Defoe's war record possible. Industrial know-how, plus willing workers, will win the war and assure an even greater post-war America."

HARRY J. DEFOE
Founder, Defoe Shipbuilding Co.

From Sugar Beets

TO WARSHIPS

FOOD and warships are vital weapons. So forty-seven per cent of the employees at Defoe not only do a full stretch of work in the shipyards, but operate their own farms as well. These farmer-workers are helping to beat the Axis by building warships and also by producing bumper yields of sugar beets and other crops.

They typify the spirit of extra accomplishment which is responsible for our record-breaking production of destroyer escort ships to help crush the U-boat menace.

The unique Defoe method of building these 1700-ton ships upside down and then rolling them over to complete their construction has doubled man-hour production. This enables twice as many

destroyer escort ships to be built at half the labor cost per vessel.

Independent of government financing, Defoe is building DE ships for the Navy on a fixed-cost basis. This program is not only saving the government millions of dollars, but priceless days in delivery time.

When the Axis is defeated, the peace-time application of our organization, war-born technical experience and advancements will provide products of better quality and at lower cost for the American consumer.

BACK THE ATTACK—BUY WAR BONDS

Defoe workers take more than 10% of their pay in War Bonds.

DEFOE SHIPBUILDING COMPANY,

BAY CITY, MICHIGAN



Three White Star Renewal Citations now decorate the Navy "E" Award won by Defoe workers.

**Ships for Victory
Servants for Peace**



YOU'VE GOT TO BE GOOD...

You'll be up there in good company when you fly with the A.A.F.!

You'll be on the same team with fighters who knocked out the Luftwaffe over Salerno . . . with bombing crews that blasted Schweinfurt and blew Ploesti off the map . . . with hunters who tracked a Jap fleet to the Bismarck Sea, and bagged every ship that flew the red-ball flag.

You'll be up there in the "big leagues" . . . and to make it, you've got to be *good* . . . and that puts it up to *you*!

If you think you've got what it takes to fly . . . if you're willing to work long hours, on the ground as well as "upstairs" . . .

Then maybe you, too, can win your wings as Bombardier, Navigator or Pilot . . .

And fly and fight with the A.A.F. . . . the greatest team in the world!



MEN OF 17...

Go to the nearest Aviation Cadet Examining Board; see if you can qualify to join the Air Corps Enlisted Reserve. If you qualify, you will receive

the Enlisted Reserve insignia . . . but will not be called for training until you are 18 or over.

Begin now to prepare yourself, mentally and physically, to be a Bombardier, Navigator or Pilot in the A.A.F. Bone up on math, physics, history, geography . . . all important subjects for a member of the Air Forces. Above all, *study hard* . . . and keep your mind alert. For the A.A.F. wants your training as an Aviation Cadet to be second to none in the world . . . so that when you win your wings, you'll be the toughest and *smartest* flyer who ever burned up the sky!

Toughen your body, too. For, as a member of a bomber crew or a fighter pilot, other men will depend on your "staying power," and you will depend on theirs. Meanwhile, see your local Civil Air Patrol officers about taking C.A.P.



Cadet training — also see your High School Principal or Adviser about the recommended courses of the Air Service Division of the H. S. Victory Corps. Both afford valuable pre-aviation training.

TO WIN YOUR SILVER WINGS...

You'll start your A.A.F. training in one of America's leading colleges (after a brief conditioning period). Here, in 5 months, you will be given the equivalent of a year of college training. From the College Training Detachment you will go on to 8 months of full flight training.

When you win your wings as a Bombardier, Navigator or Pilot, you will get an extra \$250 uniform allowance . . . and your pay will be \$246 to \$327 a month.

And after the war you will be qualified for leadership in the world's greatest new industry—Aviation!

See your nearest Aviation Cadet Examining Board—or the commanding officer of the College Training Detachment nearest you—for complete details.

(Essential workers in War Industry or Agriculture—do not apply.)

U. S. ARMY RECRUITING SERVICE

For more information see local Aviation Cadet Examining Board

For information regarding Naval Aviation Cadet Training, apply at the Naval Aviation Cadet Selection Board in any office of Naval Officer Procurement, or at any Naval Recruiting Station; or, if you are in the Navy, Marine Corps or Coast Guard, apply through your commanding officer. . . This advertisement has the approval of the Joint Army Navy Personnel Board.

"KEEP'EM FLYING!"

FLY AND FIGHT WITH THE

GREATEST TEAM IN THE WORLD



INDIAN
TRAIL BLAZERS



Voyager of Discovery

Make your voyages of discovery to America's scenic wonders on an Indian Motorcycle. No other form of transportation can wing you so easily and economically to hard-to-reach places. Your Indian seems part of you as it flashes effortlessly... with unbelievable smoothness... over thrilling miles of highway and byway. In the saddle of this modern mustang you ride with confidence and safety... with the glorious wind of freedom on your face!

Look forward to the day when you and your Indian can go adventuring together in a peaceful America.

INDIANS ON THE WARPATH

Right now, all new Indian Motorcycles go straight to war, and what a fighting record they're turning in! But new, improved, postwar Indians are already being blueprinted. *They're the motorcycles to wait for!*



**BUY WAR BONDS NOW
TO BUY AN INDIAN LATER**

Indian Motorcycle Company
Springfield, Massachusetts

Mail FREE copy of exciting Indian News.

Name.....

Address.....

City.....State.....

Indian

MOTORCYCLES

FEBRUARY, 1944

Buy War Savings Bonds and Stamps regularly.

217

FOR ACCURATE BOLT TENSION

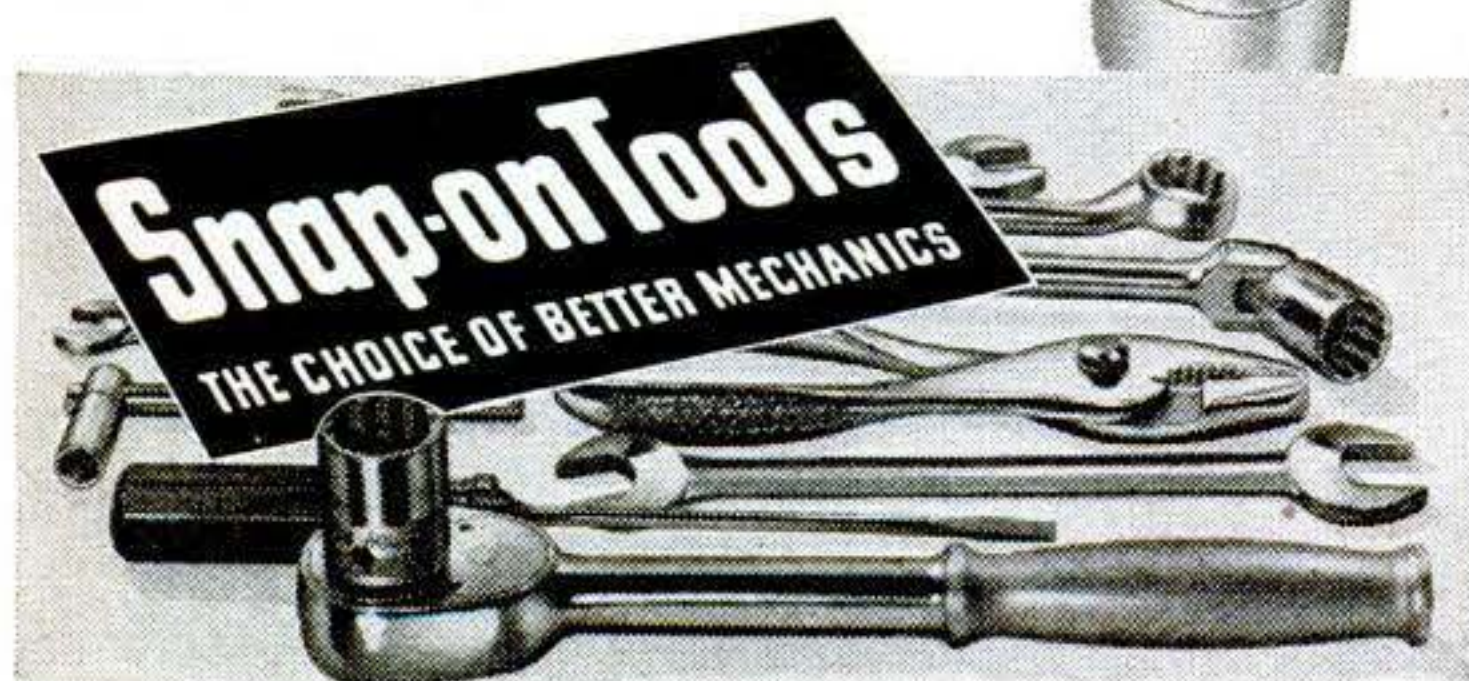
Snap-on TORQOMETERS

... MAKE CORRECT TENSIONING
EASY AS READING A WATCH

Even veteran mechanics can't be expected to *guess* correct bolt and stud tension . . . or estimate even close to uniform accuracy. But with a Snap-on Torqometer you can hit the specified pressure *every time* . . . right to the correct inch-pound or foot-pound . . . and do it swiftly and confidently! You see the pressure as the nut is turned . . . easy as reading a watch!

On fine assembly and maintenance operations, Snap-on Torqometers insure precision, eliminate the danger of mechanical distortion. As easy to use as an ordinary wrench. Available in a full range of capacities, from 150 in. lbs. to 2,000 ft. lbs.

SNAP-ON TOOLS CORPORATION
KENOSHA, WISCONSIN



Burma Is No Paradise

(Continued from page 66)

and much of Africa, joined the conversation and echoed these statements, having been a victim of Burmese malaria himself. Knowing how tough it can be when one has to "walk out" of Burma into India, as a number of his friends had to do, he designed a belt of essential supplies, which he wore constantly.

First of all, he had his pistol, but more important was his compass and his knife with a 14-inch blade. "Don't consider a knife with less than a five-inch blade," said the Captain, "and one with a 16-inch or 18-inch blade is not oversized."

In an empty canvas first-aid kit he kept 50 five-grain quinine tablets for malaria—about two months' supply, because the walk back frequently took that long. In addition, he carried about 20 sulfaguanidine tablets for diarrhea or amoebic dysentery; and 20 sulfathiazole tablets for throat infections and abrasions of one kind or another. And, of course, he carried the usual first-aid kit on his belt. For building fires for cooking and boiling water to drink, he had a cigarette lighter tucked away, with flints and fluid.

"The pistol," the Captain explained, "was necessary for protection, but it was never meant for big-game hunting. So I had one of the new carbines fastened on hooks just inside of the door of the plane, where I could grab it the last thing as I bailed out. I didn't weigh myself down with extra ammunition. I thought the single clip in it would carry me out, because the game in the Naga Hills is surprisingly tame. You can all but walk right up on a deer as it stands at a stream drinking."

"But of course," Colonel Scott interposed, "the natives of that area could be counted on to help you, which was the exact opposite of the conditions I faced. Where you were, in the area of the 'triangle' and the Naga Hills, the natives aren't Burmese, but descendants of the Tartars who came there centuries ago under Ghenghis Khan.

"The Tenth Air Force in India had offered the equivalent of \$30 for every American soldier rescued by these mountain peoples. To them, that is a munificent reward, which has turned head-hunters into guides. Injured flyers have been carried 50 and 75 miles in litters through the jungle to safety.

"Even at that, you mustn't make any sign or movement that the natives could construe as hostile, or you're a clay pigeon. If they ask for your gun, give it to them. It would offer only temporary protection, anyhow, against a tribe of wild men."



LOCKED ON THE BOLT BY THE ACTION OF THE GRIPPING RED COLLAR.

THE COLLAR IS ELASTIC, THE NUT CAN BE USED TIME AND TIME AGAIN.

MADE IN ALL SIZES AND TYPES—WITH THREADS TO FIT ANY STANDARD TYPES OF BOLTS.

WHY DO WE SAY "ELASTIC"?

This is an Elastic Stop Nut. You know it by the red collar. That collar is plastic—and elastic.

This is why the Elastic Stop Nut is different from other nuts.

When this nut is put on, the bolt threads press into the collar. It more than fits—it squeezes.

The nut can't wiggle, turn and loosen. It locks and holds tight—anywhere on the bolt.

Being elastic, the collar "comes back" after the bolt is removed. So Elastic Stop Nuts can be used over and over again and still lock.

Billions of Elastic Stop Nuts are being made today. And to our knowledge, not one in a million has ever failed.

After the war these self-locking nuts will make hundreds of things you buy safer, stronger, more durable. So watch for that distinctive red collar—it's the mark of these unusual self-locking nuts made by Esna.

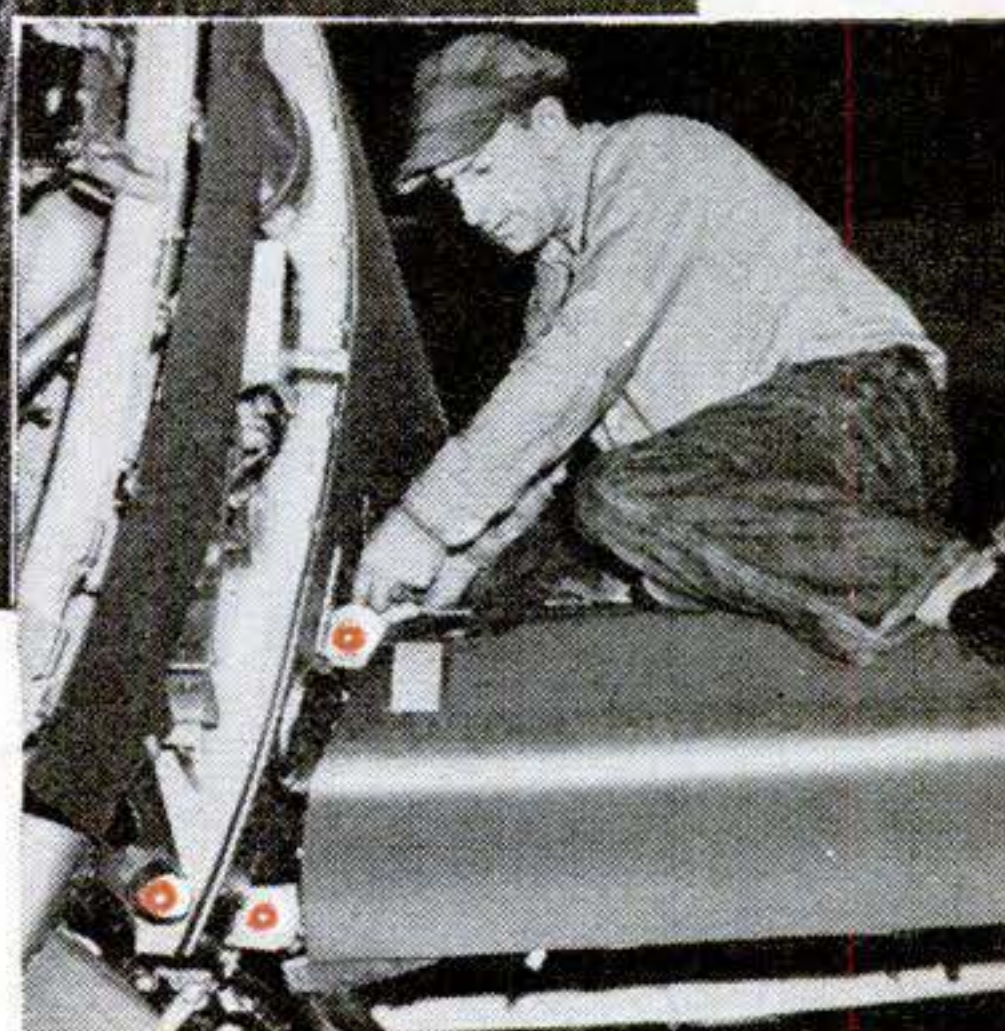
ESNA

TRADE MARK OF
ELASTIC STOP NUT CORPORATION
OF AMERICA

ELASTIC STOP NUTS

Lock fast to make things last

Union, New Jersey and Lincoln, Nebraska



WHERE ELASTIC STOP NUTS ARE GOING NOW

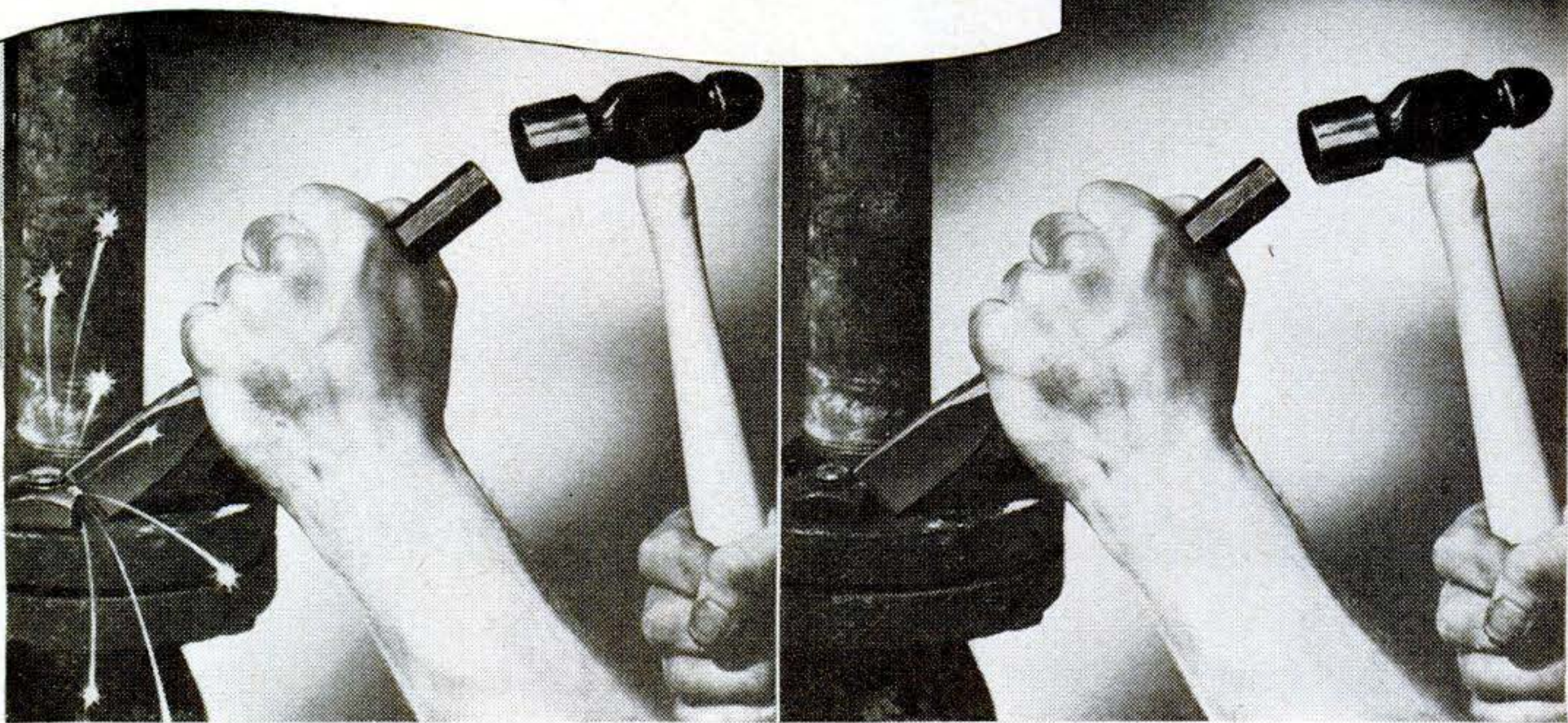


There are more Elastic Stop Nuts on America's planes, tanks and naval vessels than all other lock nuts combined. More than 12,000 of them go on the P-47 Thunderbolt. Two important applications show in the picture above.

1. Just four Elastic Stop Nuts fasten the fittings that hold each wing.
2. Just four bolts held secure with Elastic Stop Nuts fasten the throbbing 2000-hp. Pratt & Whitney engine onto the ship.

Ingenious New Technical Methods

Presented in the hope that they will
prove interesting and useful to you.

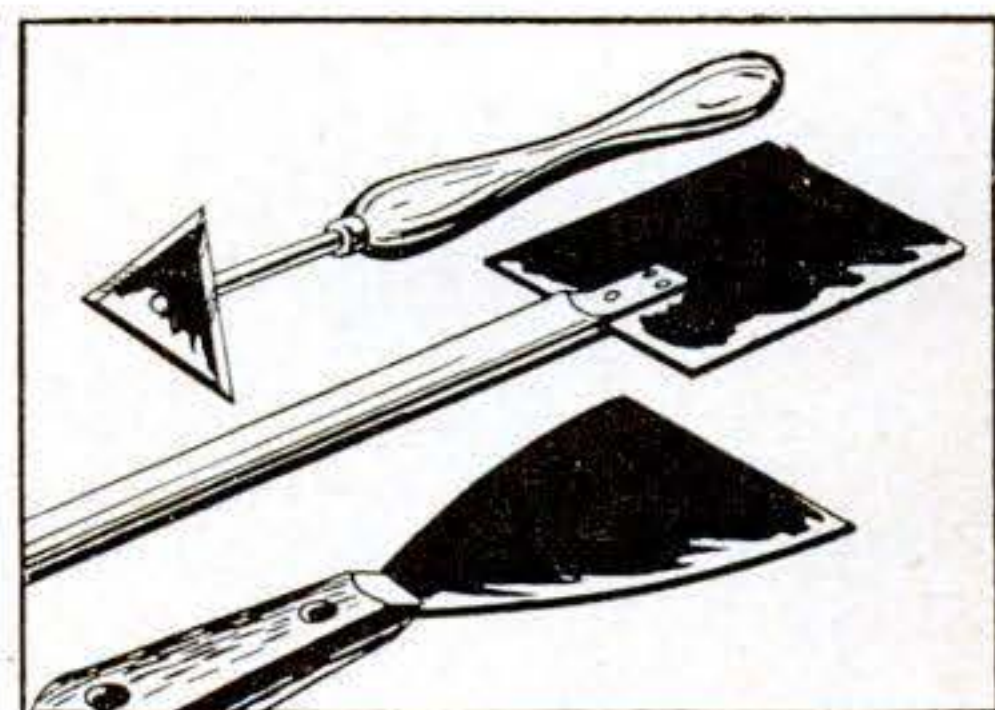


Beryllium Copper Bites Into Steel

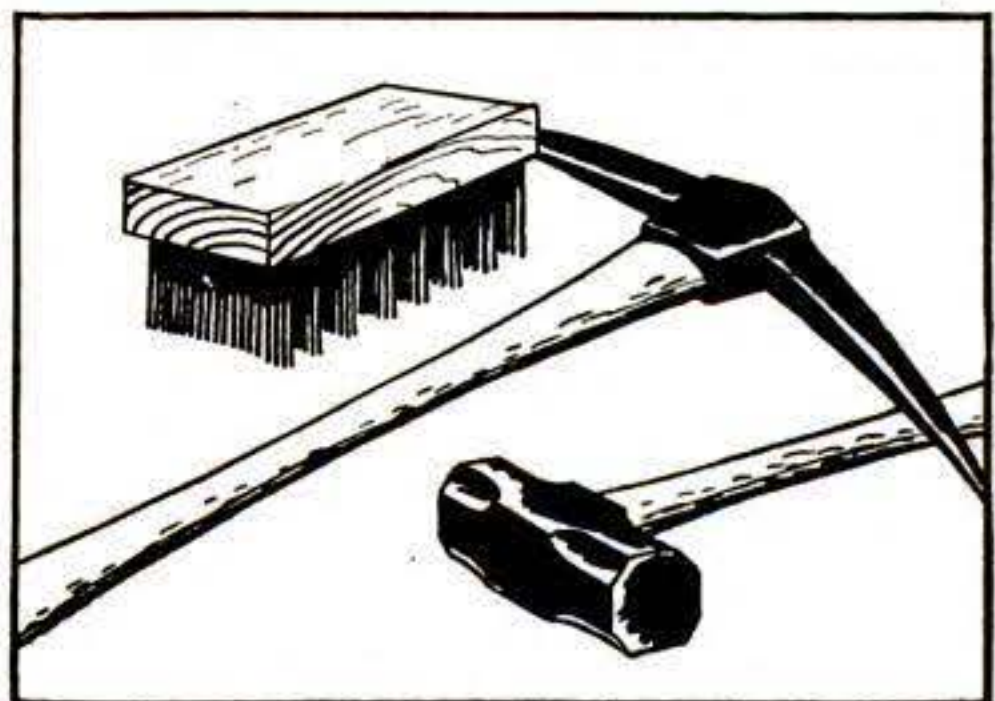
It is an old saying that when a dog bites a man it is not news, but when a man bites a dog it is news. That being the case, it is certainly news when copper bites into steel. Copper is, of course, one of the softer metals but when 2 per cent beryllium is added to copper, its characteristics are changed. The alloy is heat treatable which explains the remarkable strength and hardness. Hit a chisel made of Beryllium Copper with a hammer and it will bite into steel without dulling the edge. Tools made of Beryllium Copper are non-sparking and therefore are used in ordnance plants, oil refineries and other places where explosions may occur from sparks off steel tools. Tensile strength as high as 200,000 lbs. psi can be obtained with Beryllium Copper; hence, it is used for many applications where resistance to high loading and impact fatigue are important, such as airplane motor bushings. Most of the critical springs and diaphragms used in aviation, Navy and Signal Corps instruments are made of Beryllium Copper because of its reliability as a spring material.

We hope this has proved interesting and useful to you just as Wrigley's Spearmint Gum is proving useful to millions of people working everywhere for victory.

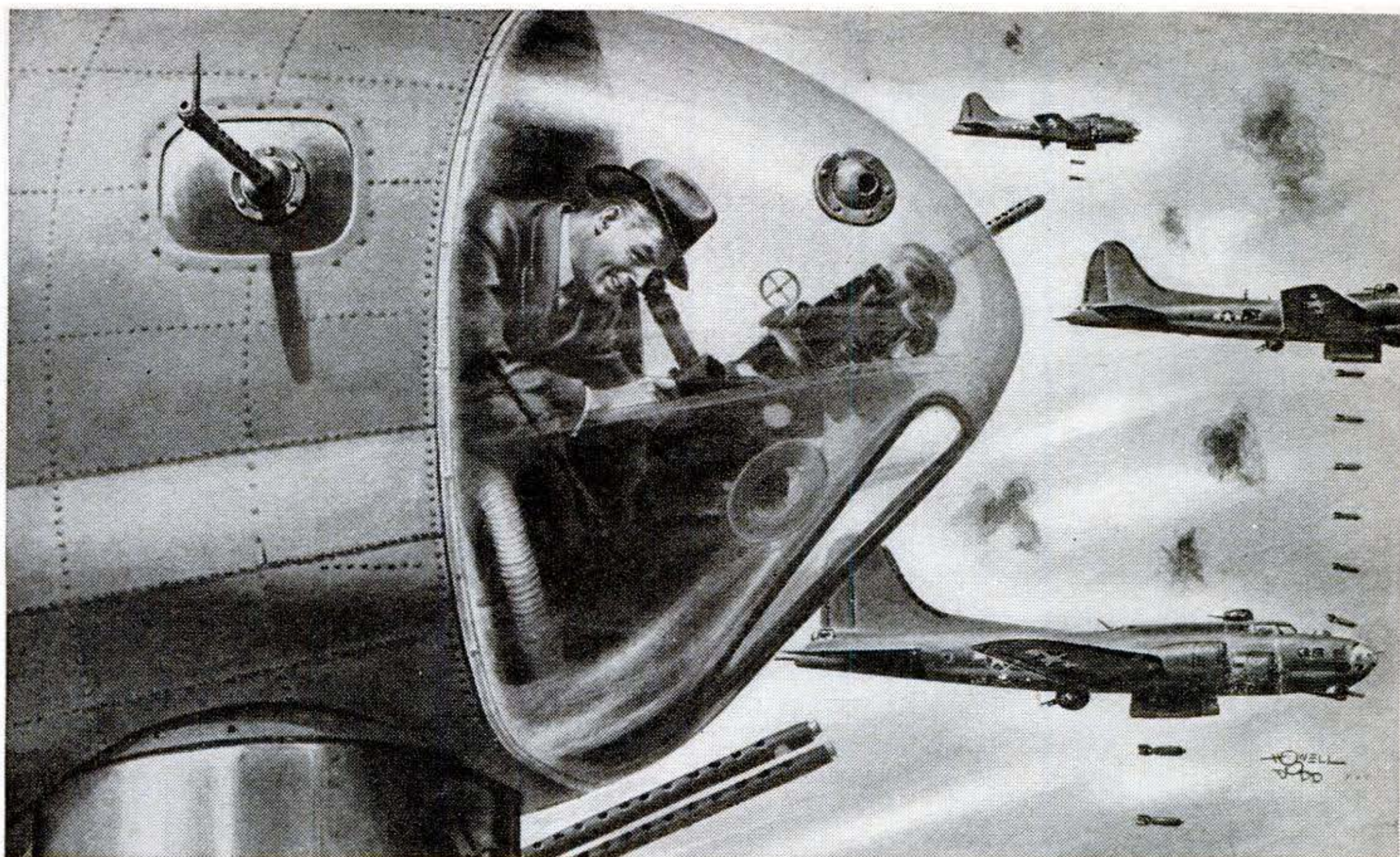
*You can get complete information
about these tools from the Beryllium
Corporation, Reading, Pennsylvania.*



Man has tried for ages to rediscover
the art of hardening copper. Today
this can be done by adding to copper
a small percentage of beryllium.



Not only does it produce an alloy
harder than tempered steel, but one
that does not produce sparks, an es-
sential when working near highly
combustible materials.



THIS IS YOU IN A BOMBER!

Yes—there you are in the nose of a Fortress—about to release ten tons of “eggs” on a Jap ammunition dump in the Caroline Islands!

Of course, you can't *really* be there in person. But you *are* represented there! The bonds you bought helped to build this Fortress . . . to pay for the bombs . . . to train the crew.

And just as these bomber crews go on hammering at Hirohito until their job is done . . . you will go on buying more bonds, saving scrap, giving blood, until final Victory is won.

Only then can we all enjoy the many startling improvements and innovations that will result from wartime research and experience.

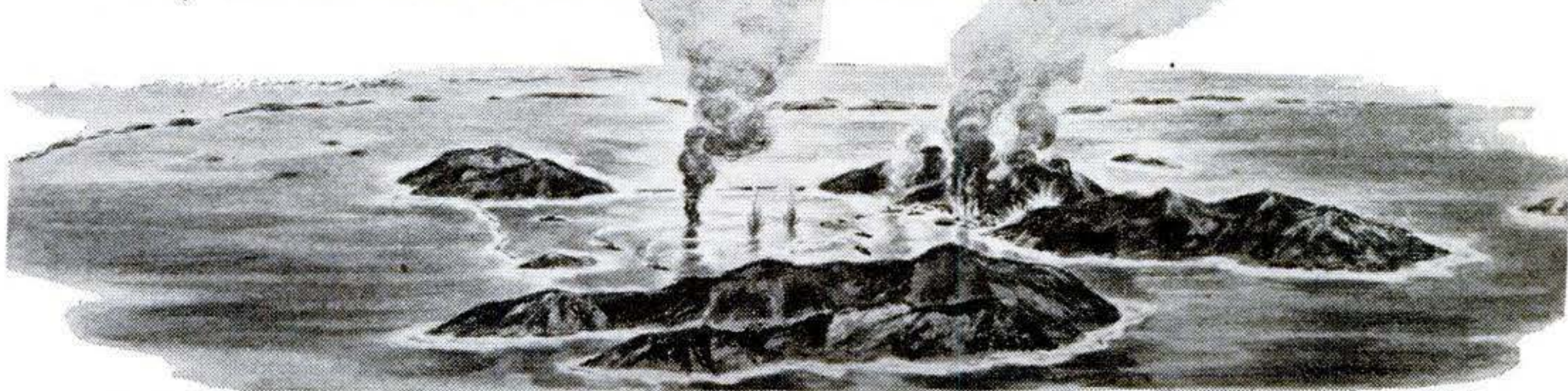
Only then can American industry show

what it has learned these past few years.

For instance, if you're a camera enthusiast, Universal will offer finer-than-ever cameras at prices well within your means. The experience gained in furnishing the Army, Navy, Marines and United Nations with precision optical equipment will open new horizons after Victory.

But in the meantime there's only one way to make that Victory—those better times—possible. That's by everyone of us backing every bomber . . . every tank . . . every sub . . . with everything we've got.

Make doubly sure of your place in that bomber—today!



There's only one flag
we're prouder of!

UNIVERSAL CAMERA CORPORATION

NEW YORK • CHICAGO • HOLLYWOOD

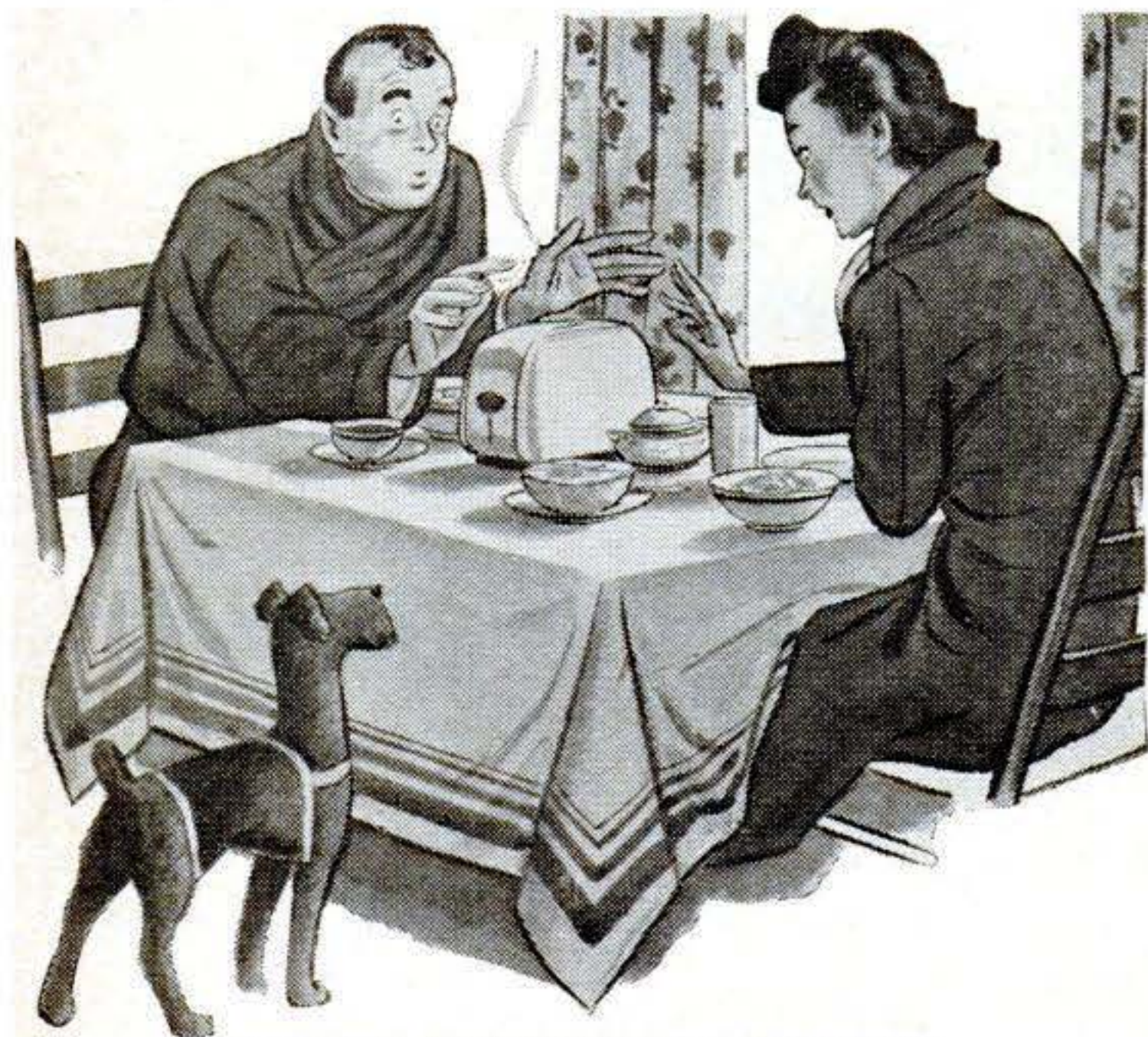
Makers of Precision Photographic and Optical Instruments • Peacetime Manufacturers of Cinemaster, Mercury, Corsair Cameras

FEBRUARY, 1944

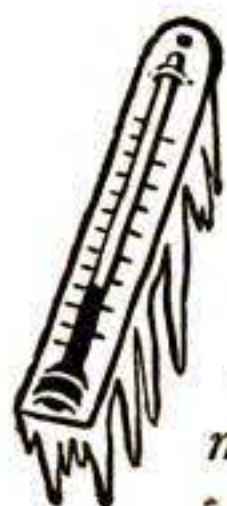
Buy War Savings Bonds and Stamps regularly.

221

Take the Br-r-r out of breakfast



KEEP WARMER WITH BALSAM-WOOL ATTIC INSULATION



A warmer house in the morning . . . more comfort all day long . . . that's what you get when you apply Balsam-Wool Insulation in your attic! And, while making your home more livable, Balsam-Wool actually saves fuel—as much as 20%, many householders find.

Easy to apply—laid like a carpet in your attic, Balsam-Wool is the original blanket insulation—windproof, moistureproof and fire resistant. It is sold under a money-back guarantee of complete satisfaction. Don't wait—see your lumber dealer now. Ask him about his monthly payment plan—or mail coupon for complete information.

Balsam-Wool

SEALED ATTIC INSULATION

Balsam-Wool . . . Products of Weyerhaeuser . . . Nu-Wood

WOOD CONVERSION COMPANY
Dept. 211-2 First National Bank Bldg.
St. Paul 1, Minnesota

Gentlemen: I want to know more about Balsam-Wool Double-Value Attic Insulation.

To assist us in giving you special information, please check: I am a home owner ☐
renter ☐ architect ☐ contractor ☐
student ☐

Name

Address

City State



Flying Big Gun

(Continued from page 108)

Colonel (now Major General) G. M. Barnes. The gun was mounted in the fuselage of a junked B-18 bomber and fired on the ground to test the reaction of the fuselage to the shock of such an explosion. These early tests were successful, considering the crude equipment.

Encouraged but still cautious, the Ordnance men next obtained flyable models of the B-18 through the co-operation of the Air Forces, and went ahead with the most dangerous part of the experiment—flight-testing and firing the old cannon.

In every case, Captain Quinn himself insisted upon taking the risk of firing the first rounds from these makeshift mounts, and to his courage goes much credit for the final outcome of these dangerous experiments.

Five different mounts for the old 75 were tested, each more effective and lighter than the last. These were developed through the co-operation of the Watervliet and Rock Island arsenals.

With traditional Ordnance caution, enthusiasm was curbed during further modification until, in 1940, an improved model was demonstrated before the Air Corps Board at Eglin Field, Fla. As a result of this demonstration, and under the direction of Colonel Barnes as Chief of the Ordnance research program, a number of industrial companies were called in to help with development and manufacturing problems.

Their wholehearted co-operation produced a 75-mm. aircraft cannon more powerful than even the old French 75, with a perfected recoil mechanism and mount that met the peculiar requirements of aircraft installation. To Victor F. Lucht, an Ordnance Department engineer, goes credit for development of the recoil mechanism and the working out of the details that assured flawless performance of the assembled gun.

After more extensive ground tests, the new 75 was taken into the air under the supervision of Ordnance personnel. Again Captain Quinn came forward to take the risks attending the first firing aloft. The results justified these risks.

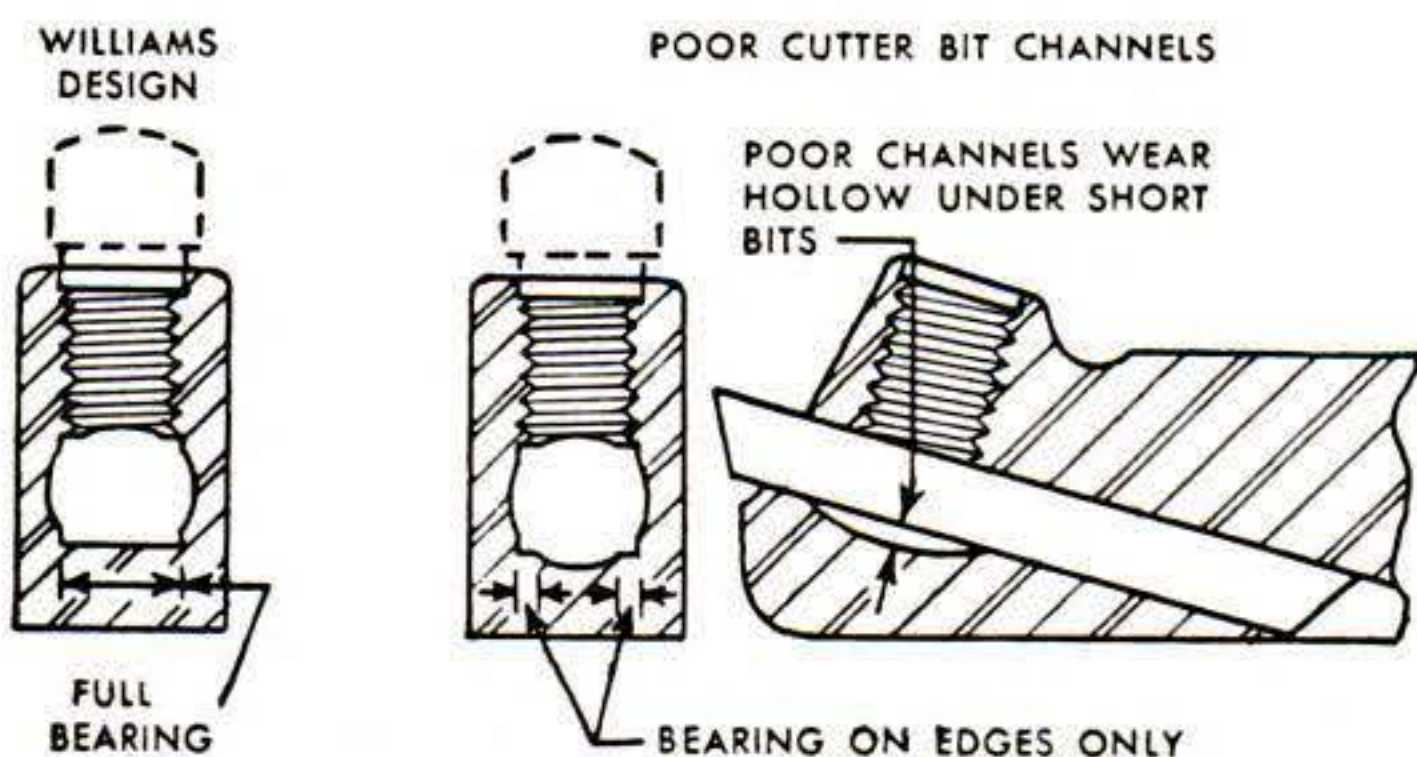
Now the problem was to find a suitable plane to take this great Ordnance achievement into combat. As this cannon was a fixed weapon, the ship to carry it had to have speed and maneuverability, with the guts to stand not only the installation weight but also the shock of firing. The size of the installation, too, had to be considered, along with the necessary equipment

(Continued on page 228)

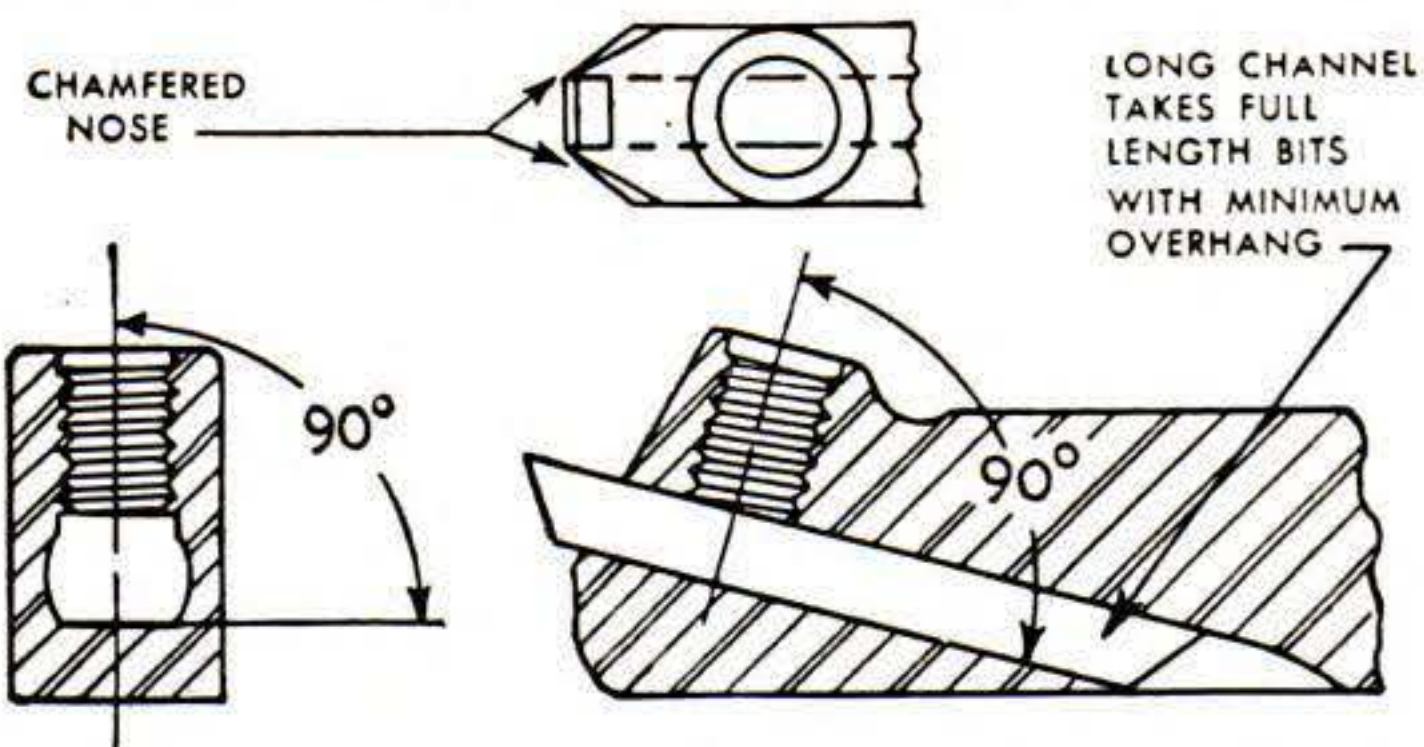
THE HOW AND WHY OF

DATA ON WILLIAMS' TURNING TOOLS (Data Sheet No. 7)

Tool Holders must be engineered to withstand the severe treatment which modern metal turning imposes on the cutting tool. Williams' Holders are drop-forged from a specially selected grade of steel, treated and hardened to develop maximum resistance to all wear and insure a hard rigid seat for the cutter directly under the holding or locking device. This tends to prevent cutter breakage which is due largely to the recess or pocket formed by short bits being forced into the cutter seat of the holder when the shank has not been properly hardened.



In Williams' Turning Tool Holders the nose is chamfered to permit convenient use in close quarters where space is limited. Set Screws are located at exact right angles to the cutter bit channel to provide full contact of the point of the screw with the cutter bit and insure maximum holding power. Screws



and tapped holes are held to the close fits essential for long life under gruelling tool holder service. Note that the extremely long cutter bit channel extends thru the bottom face of the shank, providing maxi-

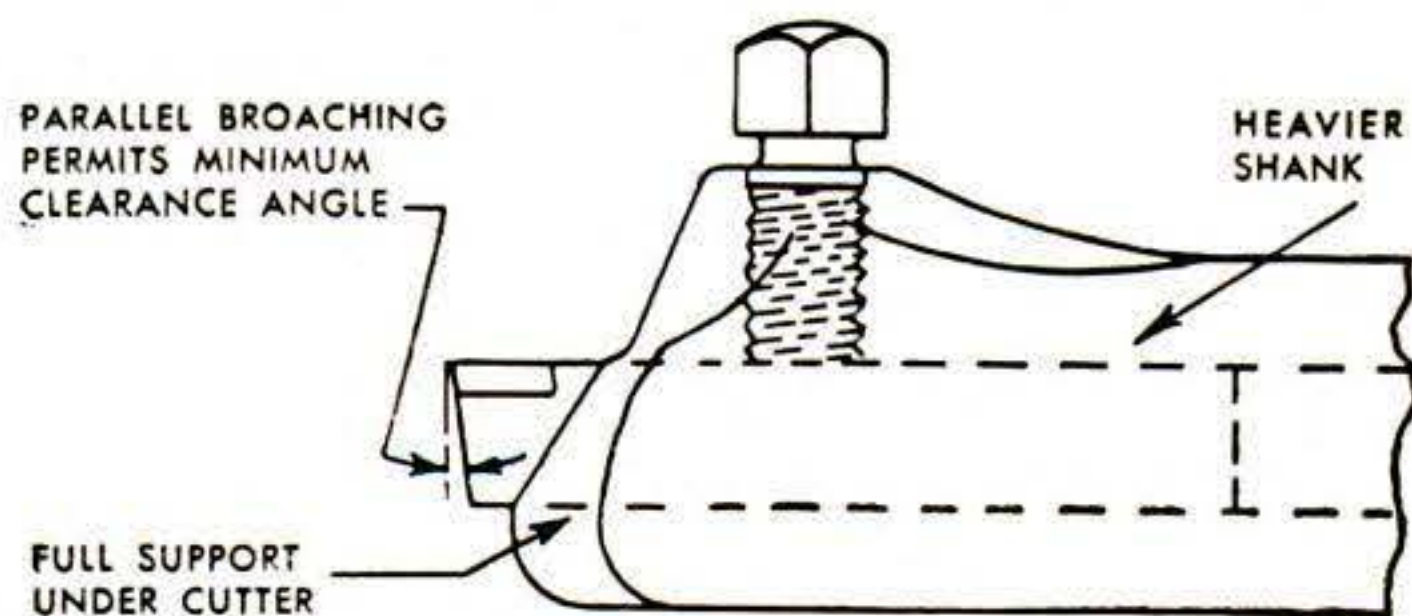
WILLIAMS

DROP-FORGED TOOLS

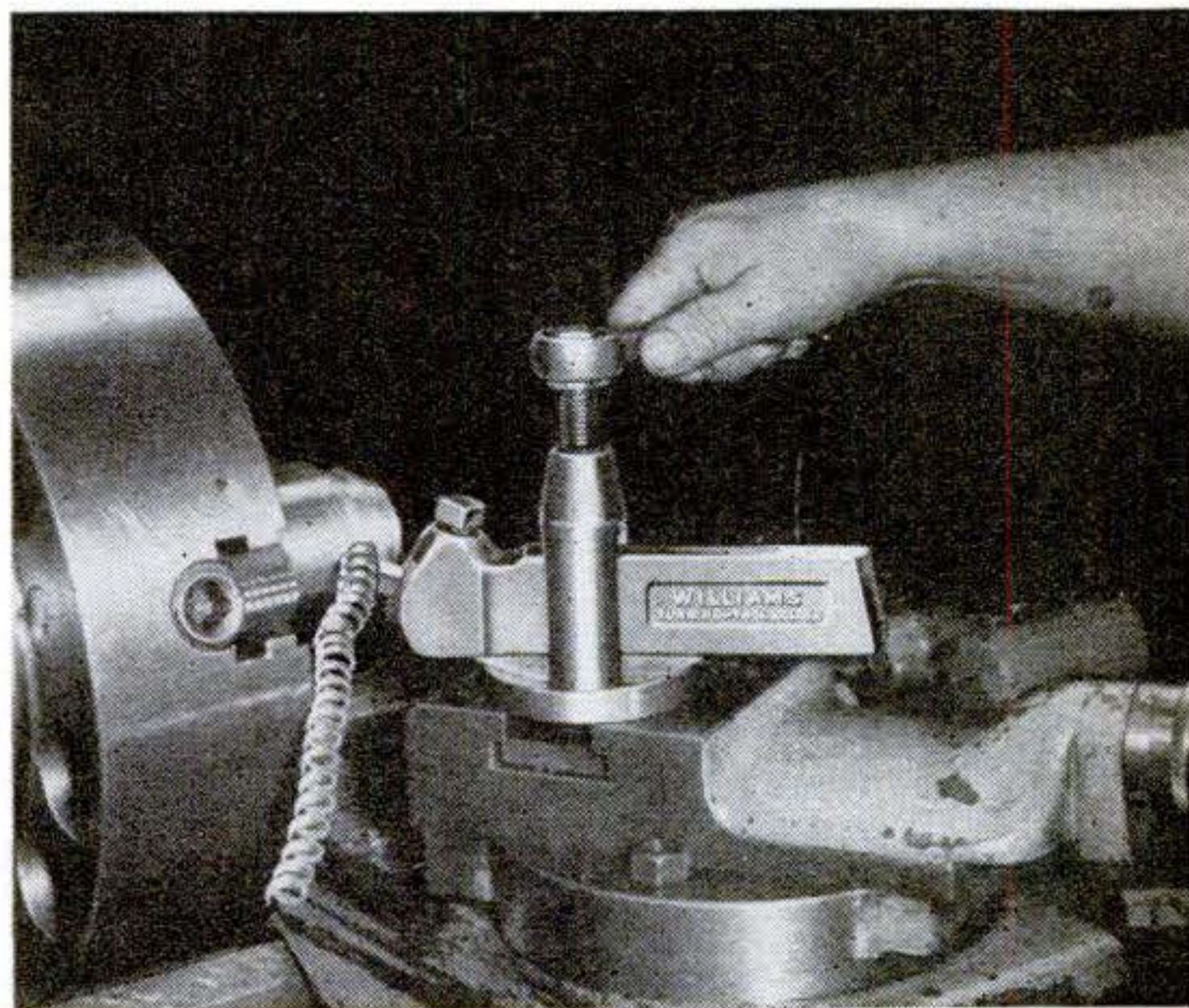
imum entry for the cutter bit. This feature assures minimum overhang when a *full-length* bit is used, thus reducing the danger of cutter bit breakage.

Carbide Turning-Tool Holders

The brittle nature of tungsten carbide makes it absolutely essential that the bit be held rigid and the cutting edge supported as much as possible. To



accomplish this, the shanks of Williams' Carbide Holders are made heavier and longer than regular Holders of equal cutter capacity. The cutter channel is broached parallel with the base of the shank rather than at the usual 15° angle. The parallel broaching of the cutter slot permits proper grinding of the cutter so as to give maximum support to the cutting edge.



FREE DATA SHEETS

J. H. WILLIAMS & CO., BUFFALO 7, N. Y.
ON USE OF SHOP AND HAND TOOLS

Your name and address in the margin below will bring 11 Tool Holder Data Sheets (punched for 3-ring binder) and a list of our complete Data Sheet series. Mail to above address, Dept. PS-2.

There is no substitute for Experience

....in Roping or Outboard Motors



BACK THE ATTACK - BUY WAR BONDS

Looks easy—when a good man does it. But just try hitting the target without *experience*!

That's what we mean about outboard motors. Good engineering, good materials, good service—all these are necessary to the ultimate enjoyment of outboard motoring. And all of these improve with experience.

Take service, for instance. Our service department, which has been at its job for 20 years, plus a *national* organization of *experienced* dealers are prepared to give Johnson owners quick, effective service *where* and *when* they need it. (Excuse us, please, if our present service for the armed forces means slower service for you.)

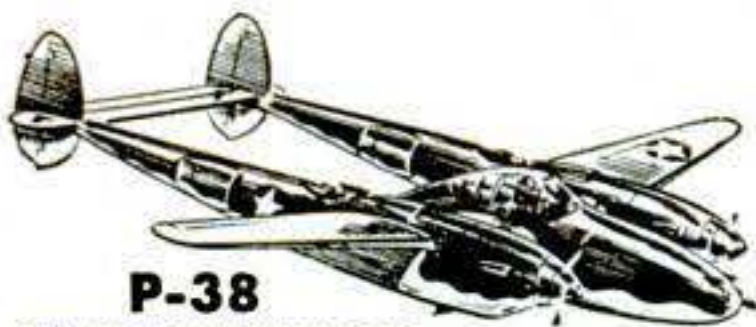


In service as in all other departments of outboard motor manufacture, there is no substitute for experience. That is a good point to remember—when outboard motors are again offered for sale.

JOHNSON MOTORS, Waukegan, Ill.

JOHNSON SEA-HORSES FOR DEPENDABILITY

When You Build CLEVELAND MODELS



P-38 "LIGHTNING"
Deadly interceptor. Span 38 $\frac{3}{4}$ ". C-D Master Kit SF-85..... **\$4.00**



P-47 "THUNDERBOLT"
The "Flying Battleship". 40,000 ft. ceiling. Span 30 $\frac{3}{4}$ ". C-D Master Kit SF-81 **\$4.00**

36-in. Industrial Training Models



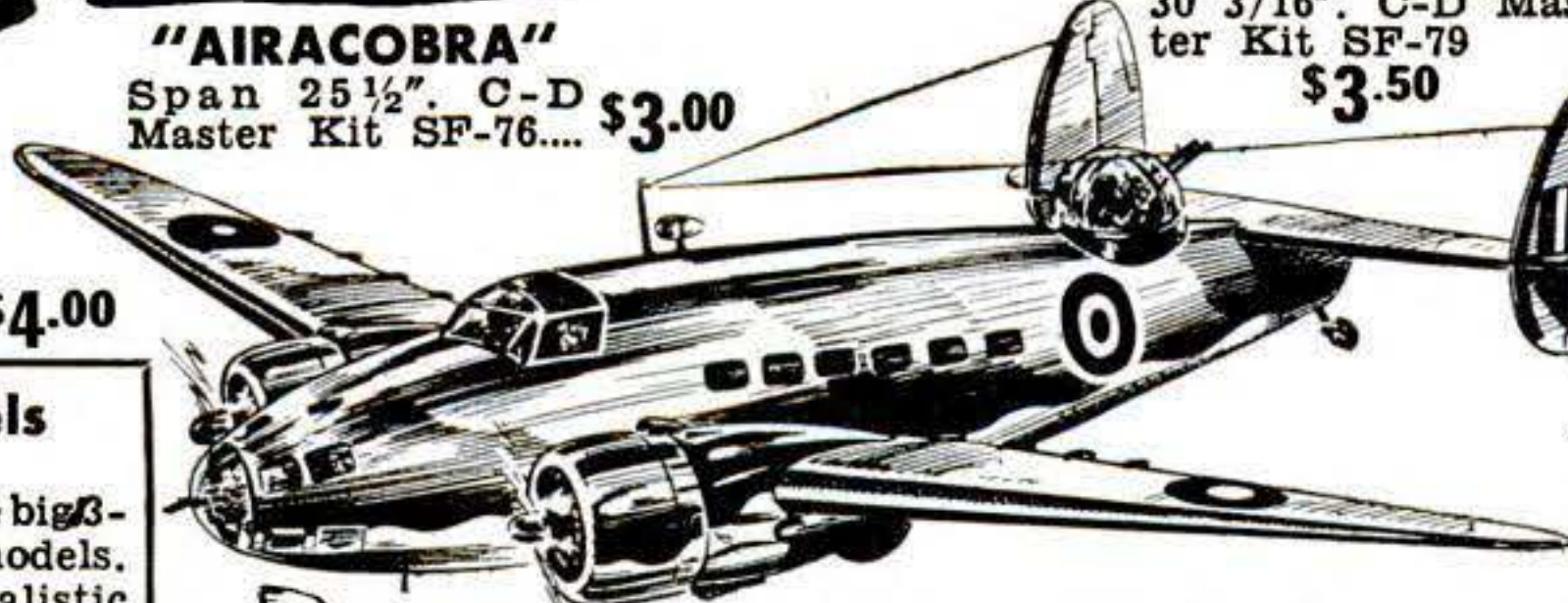
Build these big 3-ft. span models. Each a realistic beauty.

Kit T74: Messerschmitt ME-109	Kit T78: Hawker "Hurricane"
Kit T-76: Bell "Alra-cobra"	Kit T85: Lockheed P-38 "Lightning"
Kit T77: Curtiss P-40 "Warhawk" (shown)	Kit T91: P-51 "Mustang"

Each complete Kit, only **\$1.50**



"AIRACOBRA"
Span 25 $\frac{1}{2}$ ". C-D Master Kit SF-76.... **\$3.00**



Lockheed "HUDSON" Bomber

Used for bombing, fighting, reconnaissance. Called "Old Boomerang" by British, for it usually comes back. Big 49 $\frac{3}{4}$ " span. C-D Master Kit SF-95..... **\$7.50**



"WILDCAT"
"Ace of the Pacific". Span 26 $\frac{1}{4}$ ". C-D Master Kit SF-83..... **\$3.00**



"CORSAIR"
Navy fighter. Span 30 $\frac{3}{16}$ ". C-D Master Kit SF-79 **\$3.50**

Douglas SBD "DAUNTLESS"
World's hardest hitting dive bomber. Used by Navy and Marines. Span 30 $\frac{5}{8}$ ". C-D Master Kit SF-89..... **\$3.50**



"MUSTANG" (P-51Z)
Tough, vicious fighter, 350 mph. Span 27 $\frac{3}{16}$ ". C-D Master Kit SF-91..... **\$3.00**

Huge 7-Ft. Super CONDOR Glider Soars for Hours

Stronger, longer flights, more graceful lines, construction simplified. Easier than ever to build. Kit E-5019, only..... **\$1.00**



See your dealer first. If he can't supply you, order direct. Include 15c post-pack charge with ALL orders.

Send 5c for new No. 41 Catalog (none free)

Cleveland Model & Supply Co. ★ "World's Largest Mfrs. of Quality Model Aircraft Since 1919" ★ 4508D16 Lorain Ave., Cleveland 2, Ohio

You owe it to your Uncle Sam!

He needs manpower—every available person. A hearing deficiency may keep you out of the armed forces . . . but you can do your fighting on the home front . . . in war materiel plants. A good hearing aid enables you to go all out in the war effort. The movement is growing. In our plant today are workers wearing hearing aids and contributing as competently as if their hearing were normal.

You owe it to your friends!

They want to enjoy your company as much as you do theirs. Your hearing aid means as much to them as it does to you.

Are you really doing your part?

That question only *you* can answer. *Think!*

☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆

Report on a Revolution

Zenith recently started a revolution—to reduce the *cost of hearing*. After years of research and preparation, the Zenith Radionic Hearing Aid is now offered to the public.

The price—\$40—(about one-quarter that of other good vacuum tube instruments). Complete—ready to wear—with miniature radio tubes, crystal microphone and batteries—liberally guaranteed.

Inquiries from everywhere have flooded the mails—telephone calls—telegrams.

A sales volume—unheard-of in this field—is gaining daily momentum—and is a demand created by

self-evident merit of the instrument itself. Today our problem becomes one of production and distribution—to as quickly as possible make the Zenith Radionic Hearing Aid available in all localities.

We are doing our best to furnish additional manpower for Uncle Sam's production forces. And—in the doing—we are experiencing that rare satisfaction born of directly contributing to the welfare of individuals.

THE ZENITH HEARING AID WILL BE AVAILABLE THROUGH REPUTABLE OPTICAL ESTABLISHMENTS FRANCHISED BY ZENITH. (NO HOME CALLS OR SOLICITATIONS)

Write us for address of outlet nearest to you.

☆ ☆ ☆ ☆

There are cases in which deficient hearing is caused by a progressive disease and any hearing aid may do harm by giving a false sense of security. Therefore, we recommend that you consult your otologist or ear doctor to make sure that your hearing deficiency is the type that can be benefited by the use of a hearing aid.

TO PHYSICIANS:

A detailed scientific description will be sent upon request. Further technical details will appear in medical journals.



The New Zenith RADIONIC HEARING AID

\$40⁰⁰ READY TO WEAR

Complete—with Radionic Tubes—Crystal Microphone and Batteries . . . *Liberal Guarantee*

Zenith has built the best that modern knowledge and *radionic* engineering make possible into this \$40.00 hearing aid. It has no other models . . . *one model . . . one price . . . one quality.*

Write for Free Descriptive Booklet

ADDRESS DEPT. PS-2, HEARING AID DIVISION

ZENITH RADIO CORPORATION
CHICAGO 39, ILLINOIS



Wanted

POSTWAR PRODUCTS

- ★ **Have you a good idea** for a post-war product—a patent—a fully-developed commodity with national volume sales possibilities that can be produced in whole or part from metal stampings? Write us about it now—in confidence.
- ★ **More than a quarter century's experience** in the fabrication and assembly of metals of all descriptions, plus expanded facilities and skilled manpower, will enable us to manufacture and merchandise soundly-designed, new products for peacetime demands.
- ★ **We will acquire the items** selected by our Postwar Products Committee either by purchase, royalty or contract.
- ★ **If you know of a product** that you believe we can manufacture to advantage, please send complete information by letter, accompanied by blueprints, drawings or sketches.
- ★ **Your suggestions** will be held in strict confidence and fully protected here. We will review them with care and interest, and arrange for a personal interview if we wish to consider them in detail.

Please address:

Postwar Products Committee

THE GEOMETRIC STAMPING COMPANY
1115 East 200th Street • Cleveland 17, Ohio

GEOMETRIC

Sound: Wartime Tonic

(Continued from page 128)

Findings of Dr. Harold Burris-Meyer and his chief assistant, R. L. Cardinell, have aided hundreds of plants.

Too much music in industry is like too much ice cream—sickening. Cardinell's tests show that when music is played continuously workers fail to react at all. All kinds of timing have been tried. Music for one, two, three hours. Music for ten minutes—off ten—on ten. Music for intermittent 30-minute periods. Music for one hour at start of work and before closing.

This is the best advice to date:

Two hours of music is sufficient for any eight-hour work period.

Avoid identifiable vocalists or tricky instrumental music. "Deep in the Heart of Texas," for instance, is out. It stops work because, naturally enough, workers feel obliged to clap the chorus.

In general, use familiar music—dance tunes, Viennese waltzes, and the like.

Provide bright, snappy music at start of work and just before daily fatigue points.

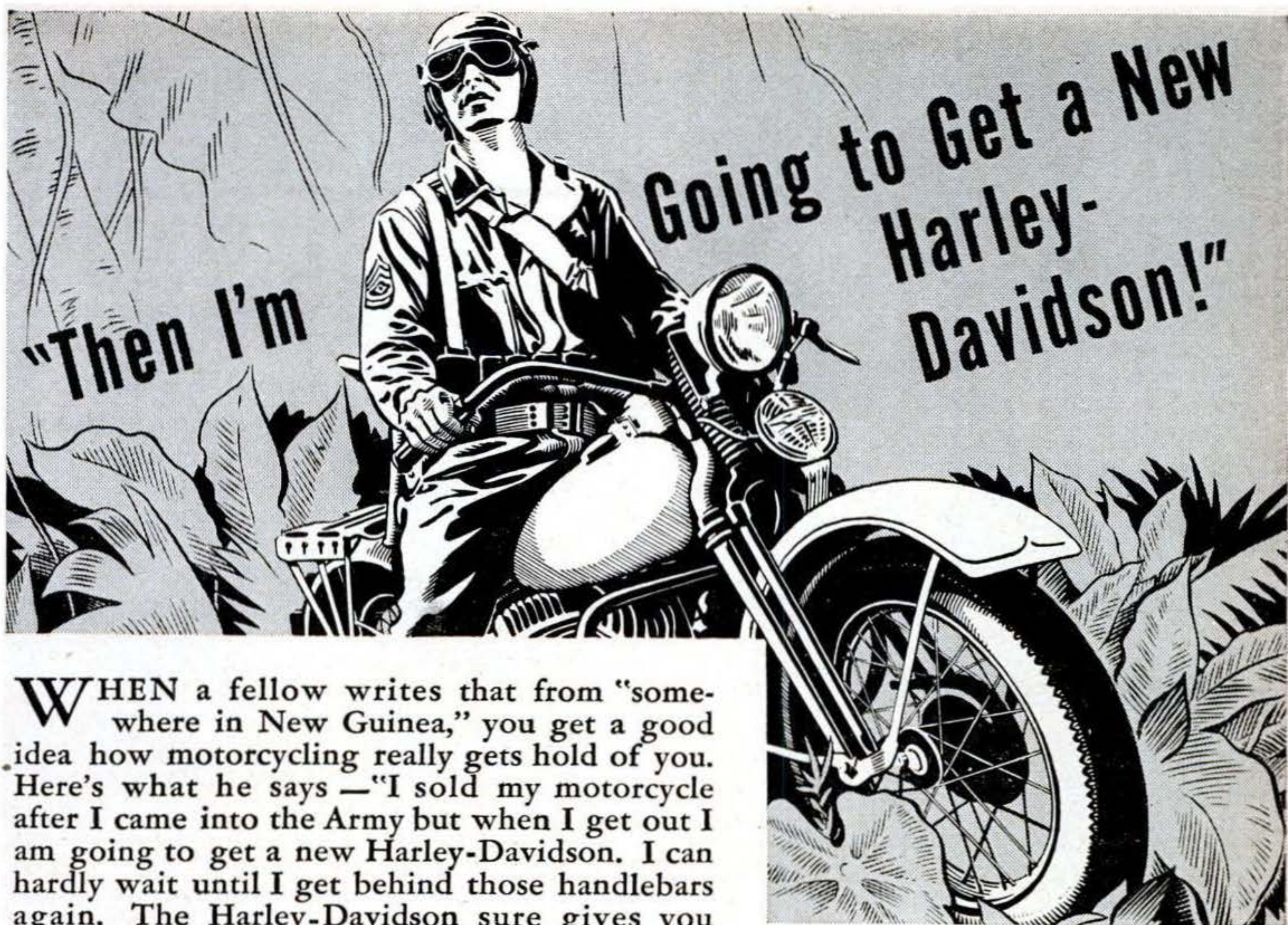
Don't play music louder than is necessary for good definition. It should be background, not spotlighted effect.

Select music so as to create a progressive mood, building up intensity and tempo from operetta to waltz to foxtrot. This gives the worker a gentle push, and has a carry-over for an hour or more.

Requests of workers should consume luncheon programs, and may include numbers regarded as too "hot" to work by.

ANSWERS TO QUIZ, PAGE 127

(1) "Hike Notre Dame"; College marches are preferable to military music, as the latter tends to depress workers by calling to mind loved ones in the service. (2) "You Are My Sunshine"; religious music often stops work like a fire gong. (3) "Merry Widow" Waltz; polkas are too fast and too noisy for good work on assembly lines. (4) "William Tell" Overture; war songs tend to depress employees, especially women. (5) "Auld Lang Syne"; so-called "high-brow" music is incongruous in a war plant. (6) "Sweet Leilani"; raucous vocals are taboo. (7) "Ah! Sweet Mystery of Life"; playing the national anthem often stops work by causing workers to stand at attention. (8) "One Alone"; there is too much action in "Irish Washerwoman." (9) "Home on the Range"; ragtime and fast swing music upset workers' production rhythm. (10) "Why Do I Love You?"; noisy South American numbers are disturbing to most war workers.



WHEN a fellow writes that from "somewhere in New Guinea," you get a good idea how motorcycling really gets hold of you. Here's what he says — "I sold my motorcycle after I came into the Army but when I get out I am going to get a new Harley-Davidson. I can hardly wait until I get behind those handlebars again. The Harley-Davidson sure gives you economical transportation. So until this is over and I am back in the saddle, keep them rolling."

You bet, Dave — we're keeping 'em rolling to the armed forces so you'll be back home sooner. And in the race meets, gypsy tours, hillclimbs and endurance runs to come, war-proved Harley-Davidsons will be out in front! Lots of fellows are buying War Bonds now — to get new Harley-Davidsons after Victory!



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Flying Big Gun

(Continued from page 222)

and accessories and a man to load the gun.

Several manufacturers were consulted. It was a lucky break when North American Aviation came forward to offer the Mitchell B-25 bomber as the steed. Already it had been battle-proved on every front. If it would do, months would be saved in getting the gun into combat.

By a happy design coincidence the Mitchell was ideal. Along the left side of the fuselage, under the pilot's compartment, it had a tunnel used by the bombardier in getting into his nose position. This might be just the spot for the placing of the gun.

To North American, then, was given the exacting problem of installing the 75 in a combat aircraft for the first time. Company experts received the drawings of the gun and installation in mid-August 1942, and George Bussiere, staff engineer in charge of ordnance, gathered his able assistants about him and dug in for a session of sweat and toil.

What they really had to work with were the M-4 aircraft cannon and the M-6 aircraft-type mount as developed by the U. S. Army Ordnance Department. What they had to achieve was the attaching of these units to the Mitchell medium bomber.

First the group studied the Mitchell's structure to see if it would do "as is." It would—on paper—for months before added ruggedness had been built in to support the nose wheel. Tests were made, and the consensus was that she could "take it."

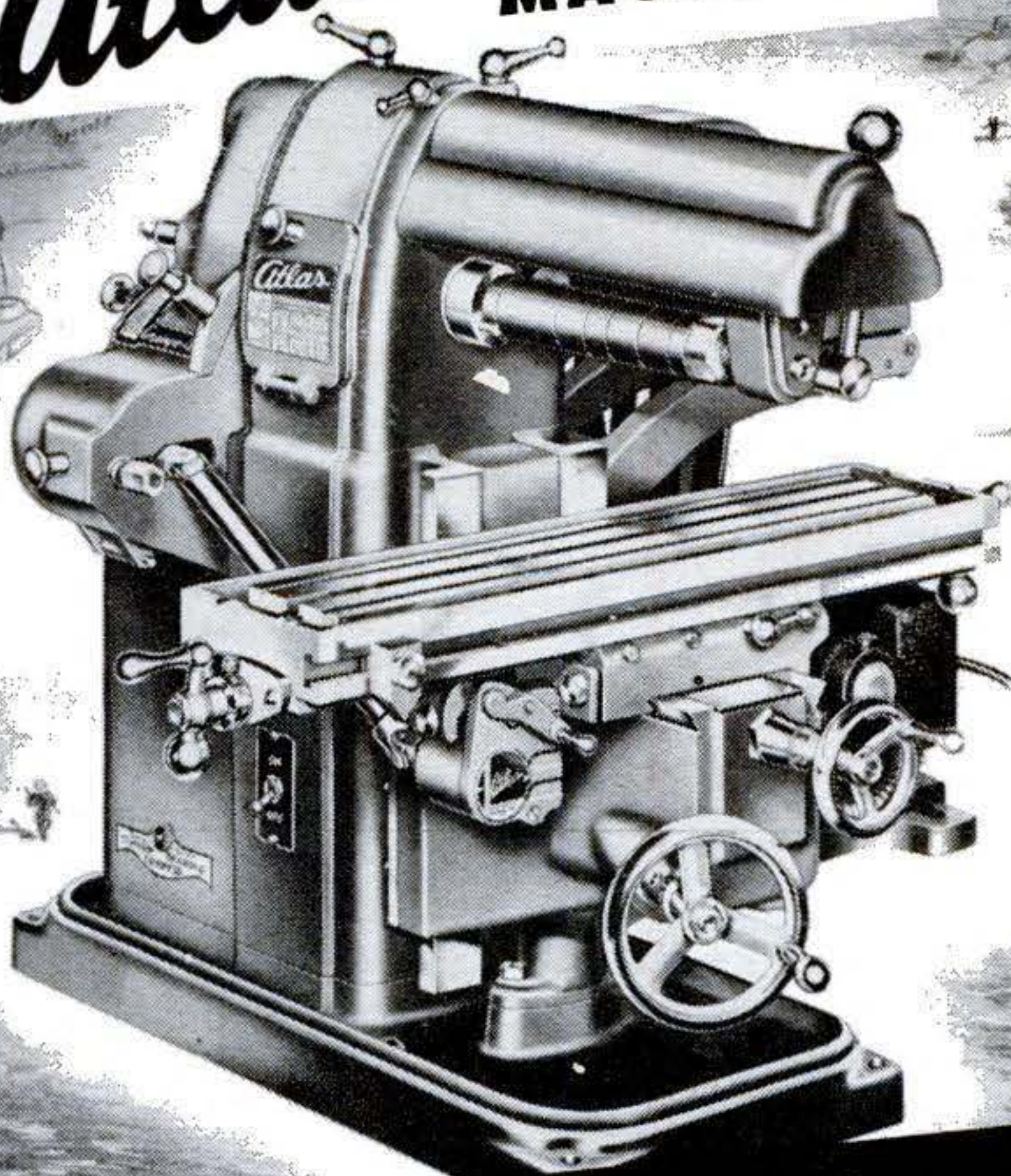
To accommodate the gun muzzle, a mild-steel port was fitted to the nose of the ship at the end of the bombardier's tunnel. The nose itself was entirely enclosed in metal, replacing the transparent sections in the standard model. Above the cannon muzzle, mountings for two .50 caliber machine guns were fitted as auxiliary weapons, and the necessary armor was added for safety.

During the next four months, test sections of the altered fuselage were taken under wraps to isolated sections of the California coast for testing on a 200-yard range. Here, in utmost secrecy, test firings were made with loads ranging from half charges to more than 115 percent of normal combat charges. As the thunder of these explosions died away, the sections were started back for a final check at the factory, where the verdict was pronounced with satisfied grins: "She can take it—and plenty more!"

Just three months from the day when Bussiere first opened the blueprints, test-pilot Rudd was firing the 75 over the Pacific.

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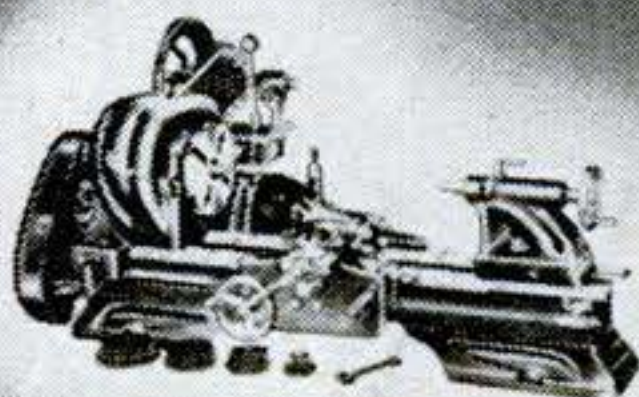
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FEBRUARY, 1944

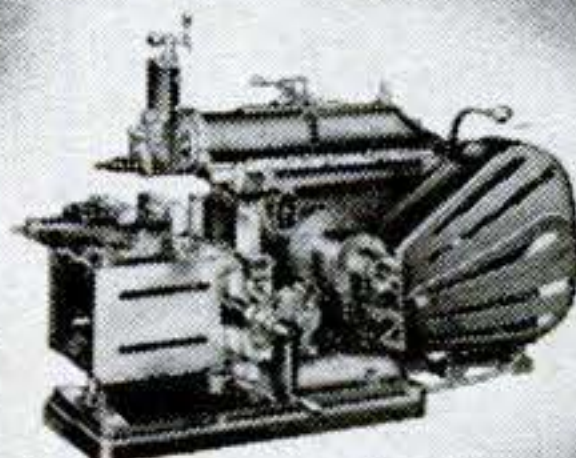
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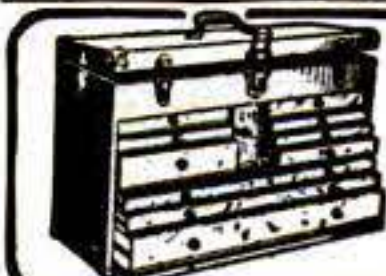


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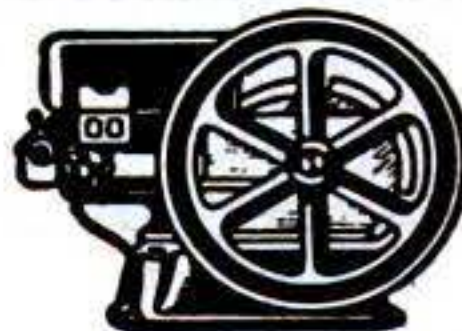
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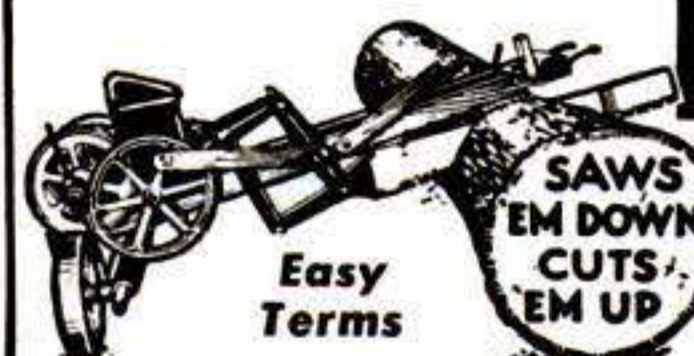
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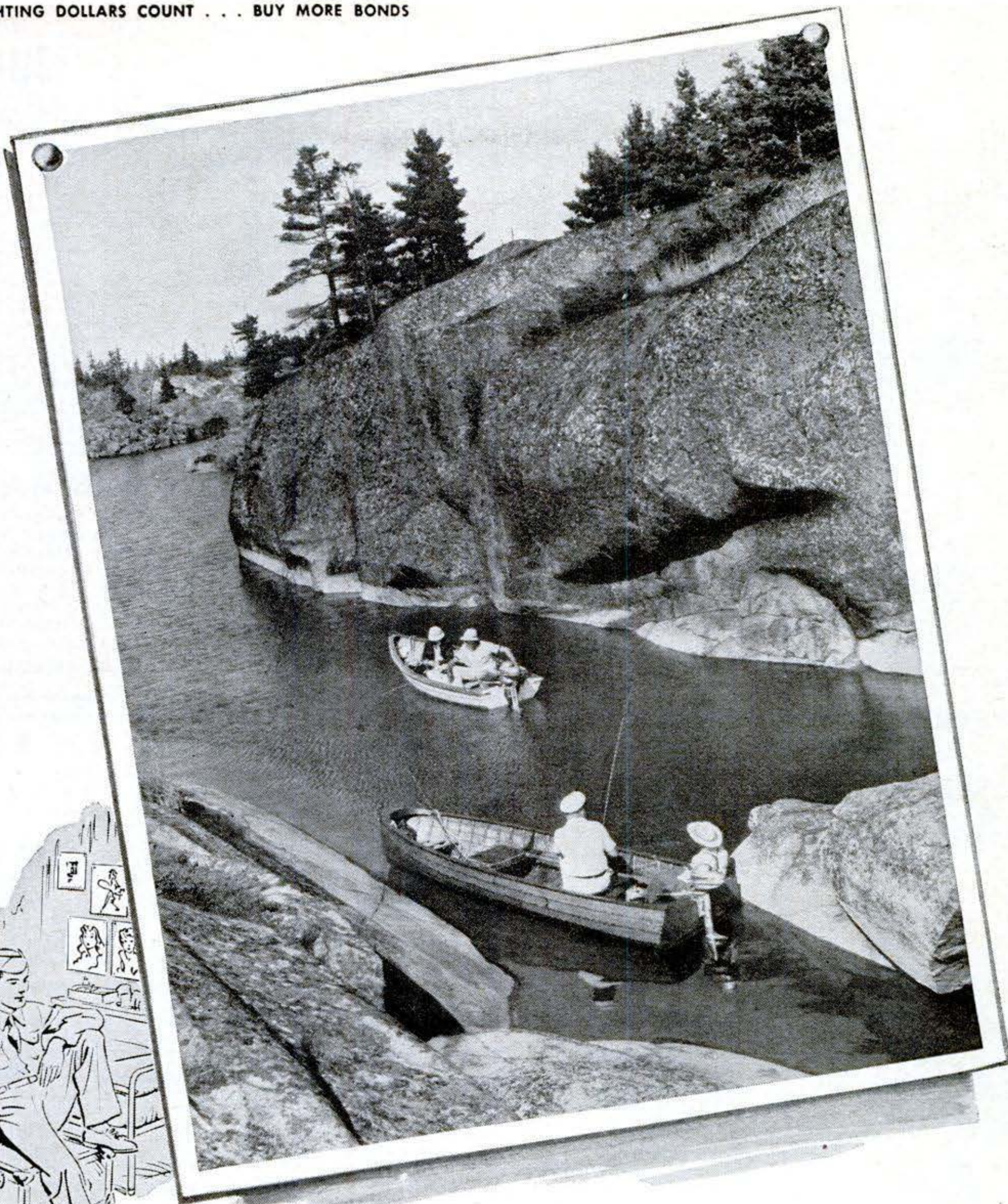
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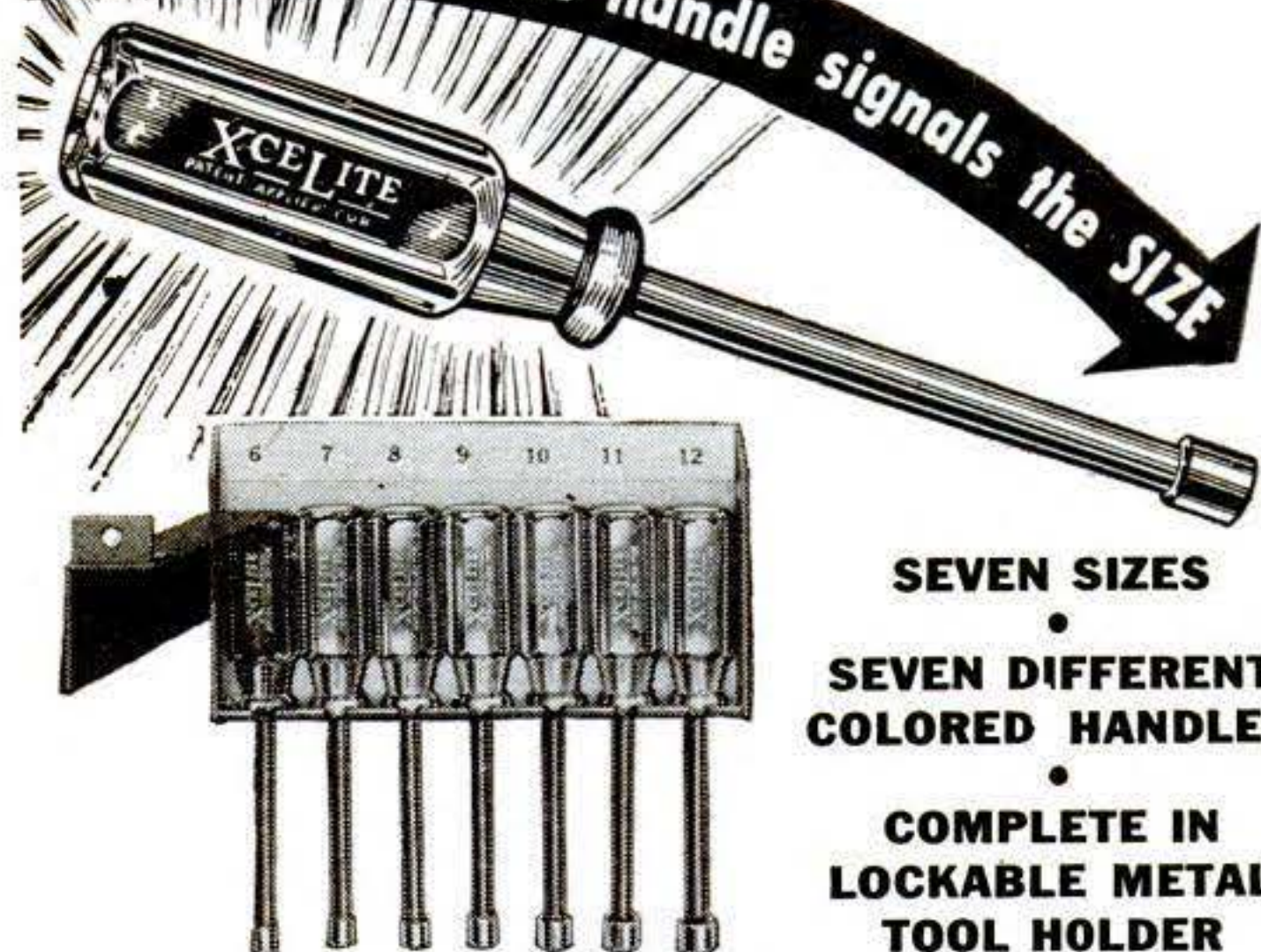
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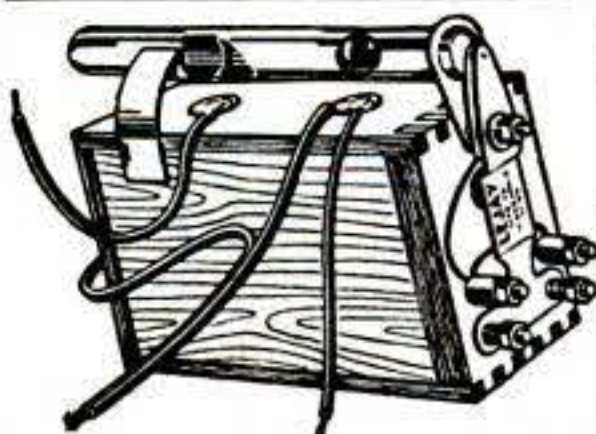
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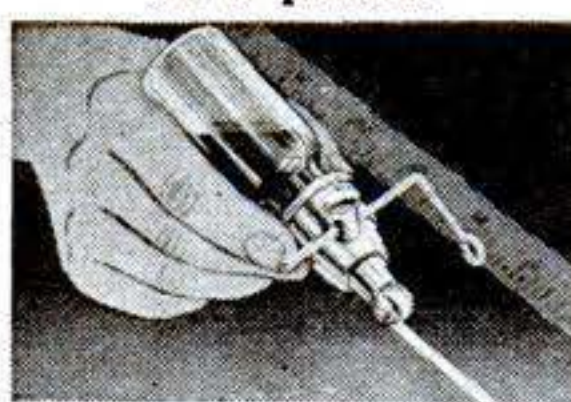
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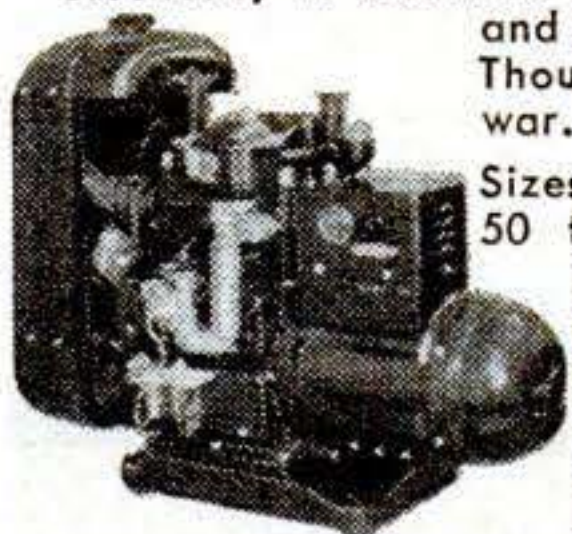


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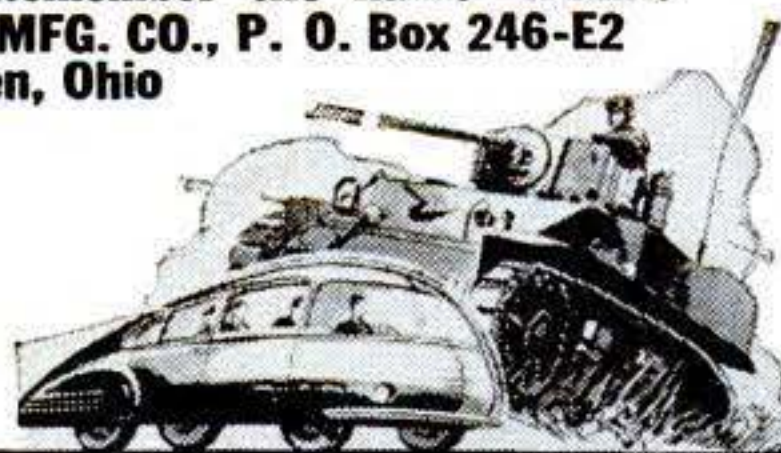
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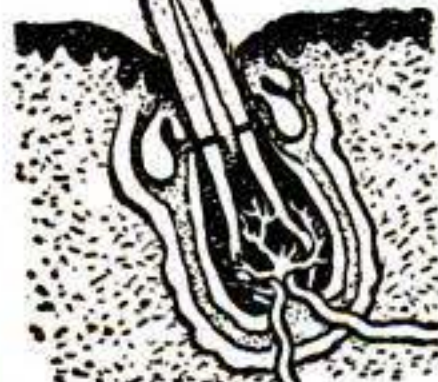
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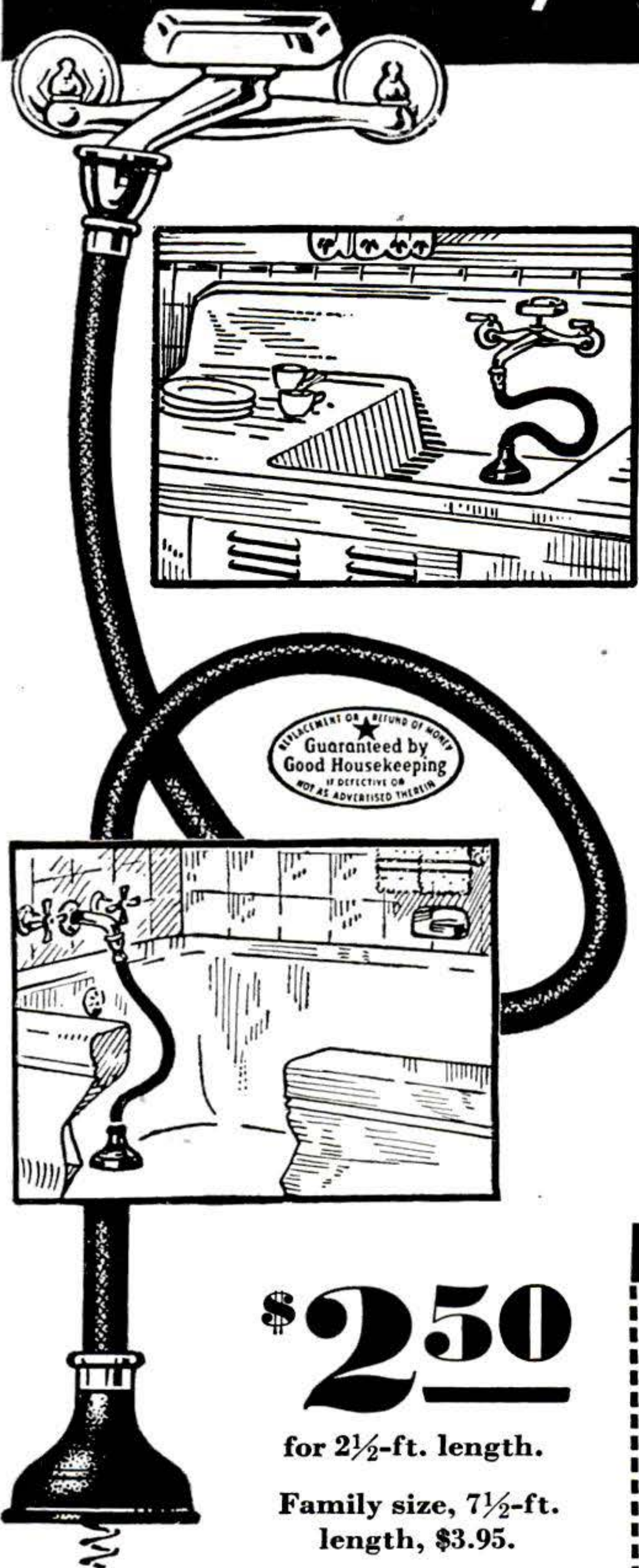
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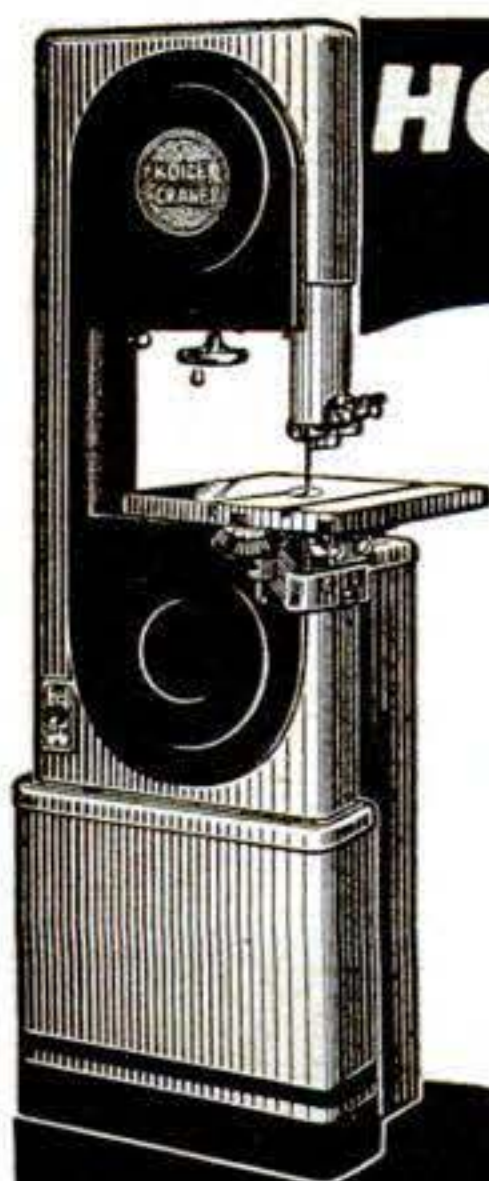
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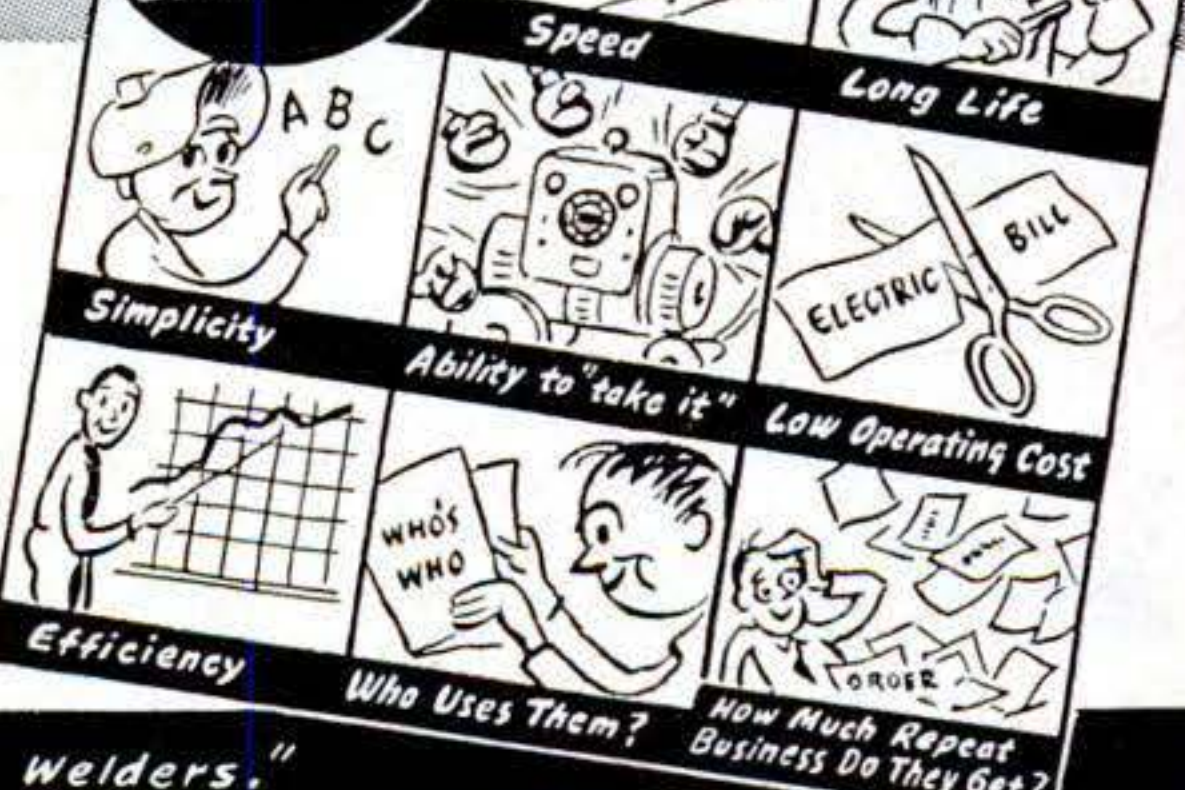
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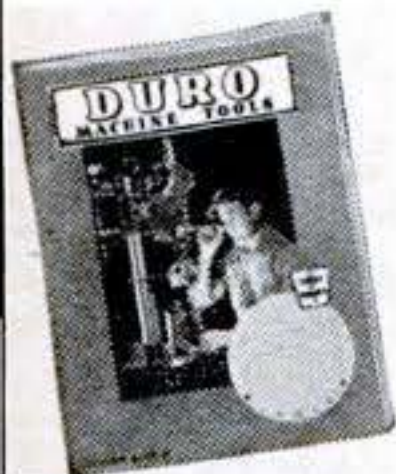
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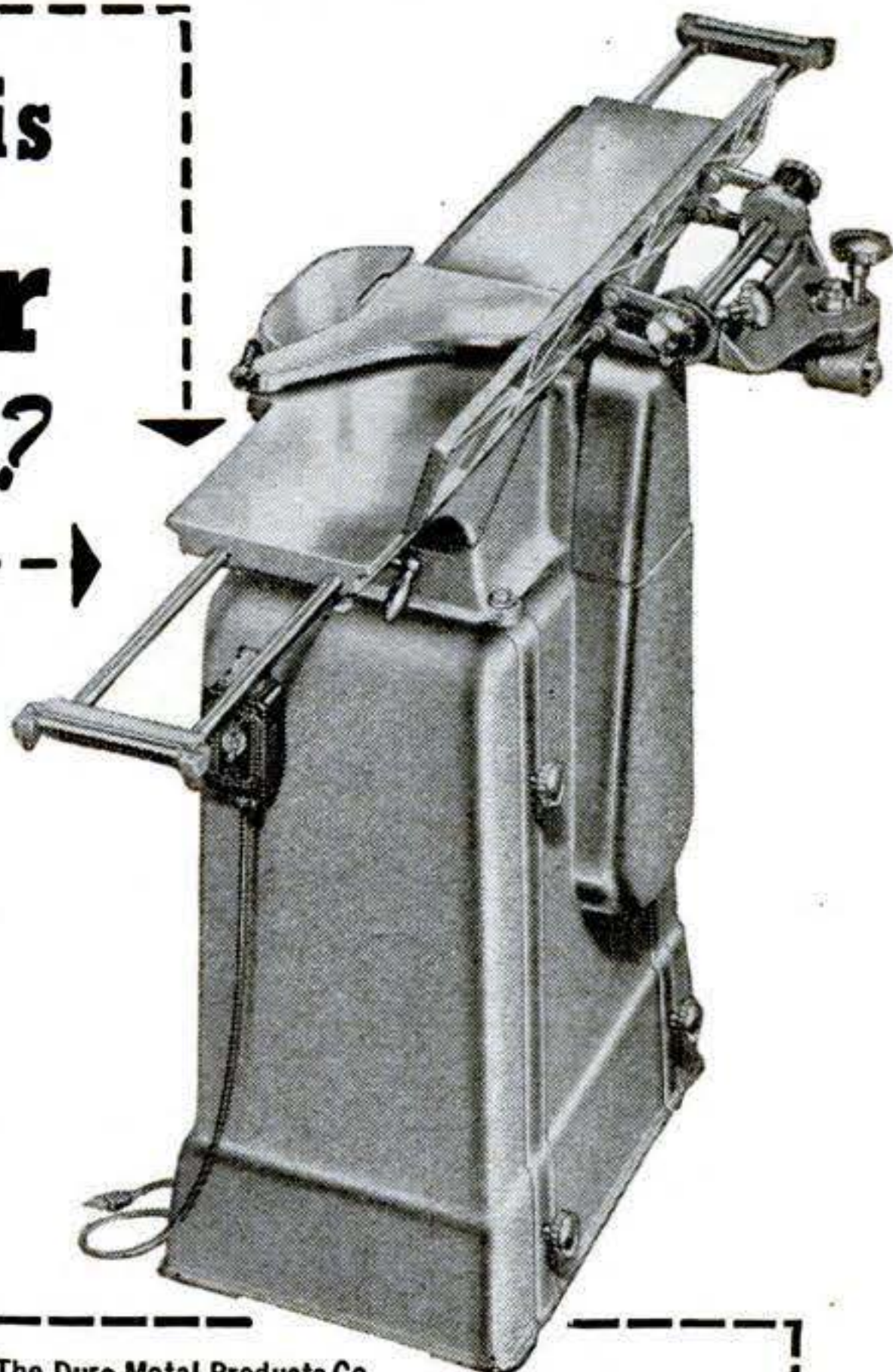
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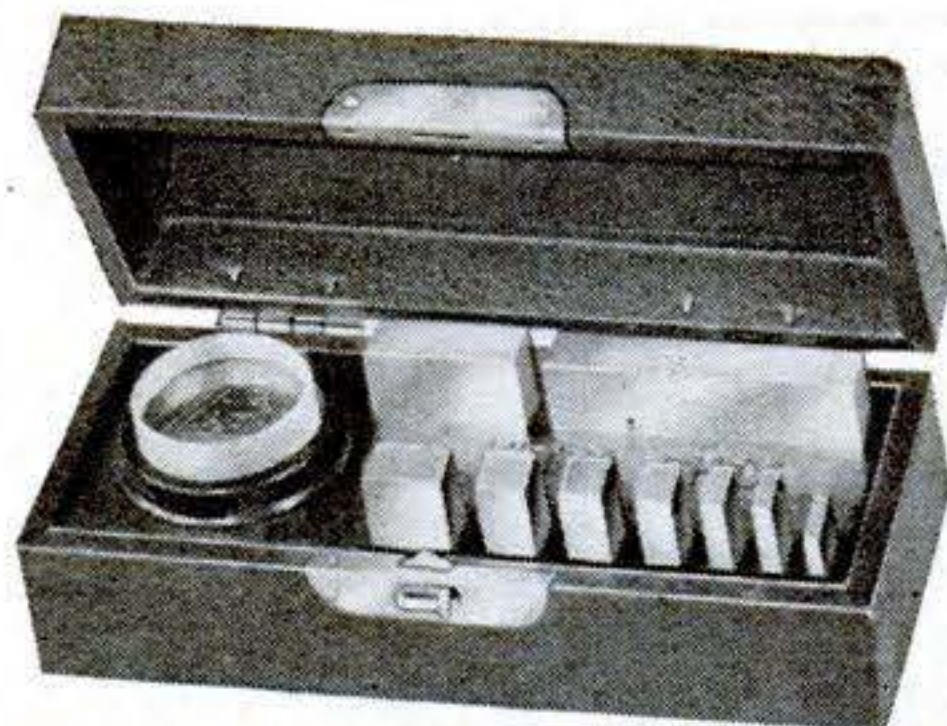
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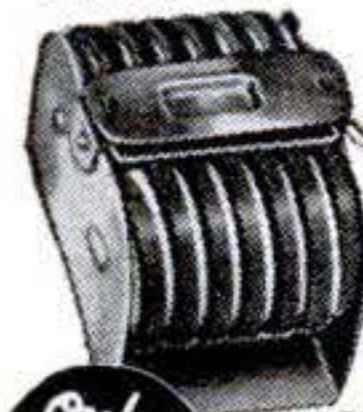
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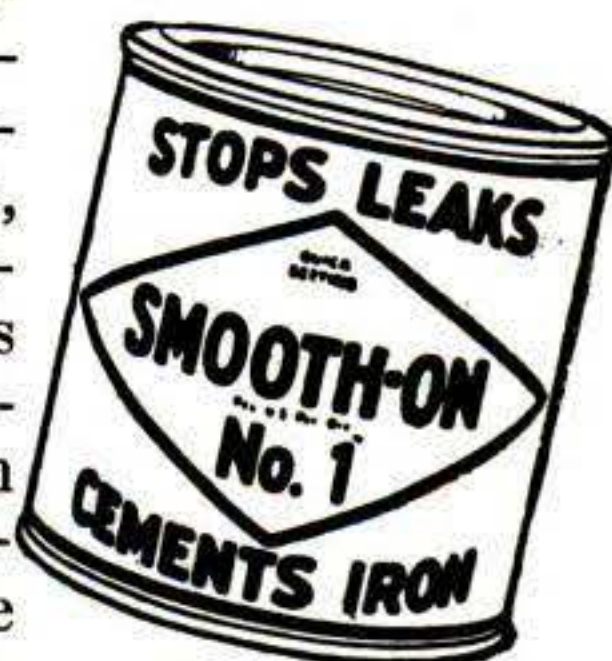
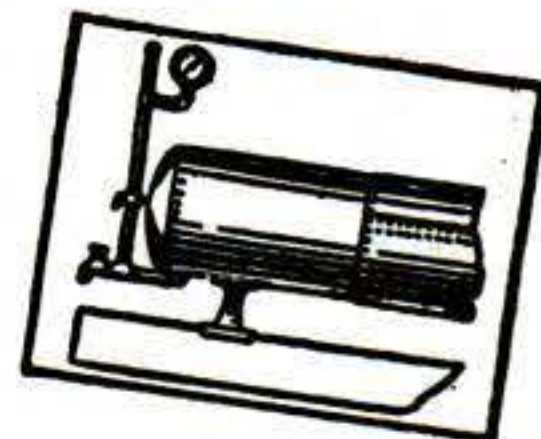
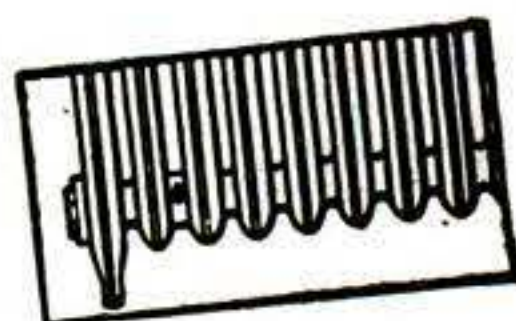
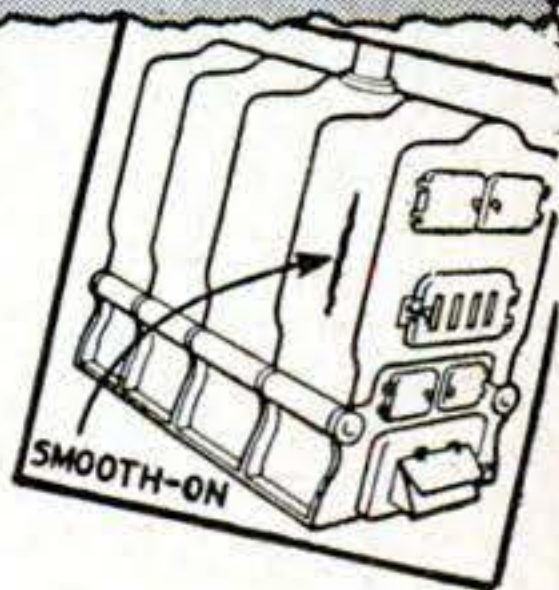
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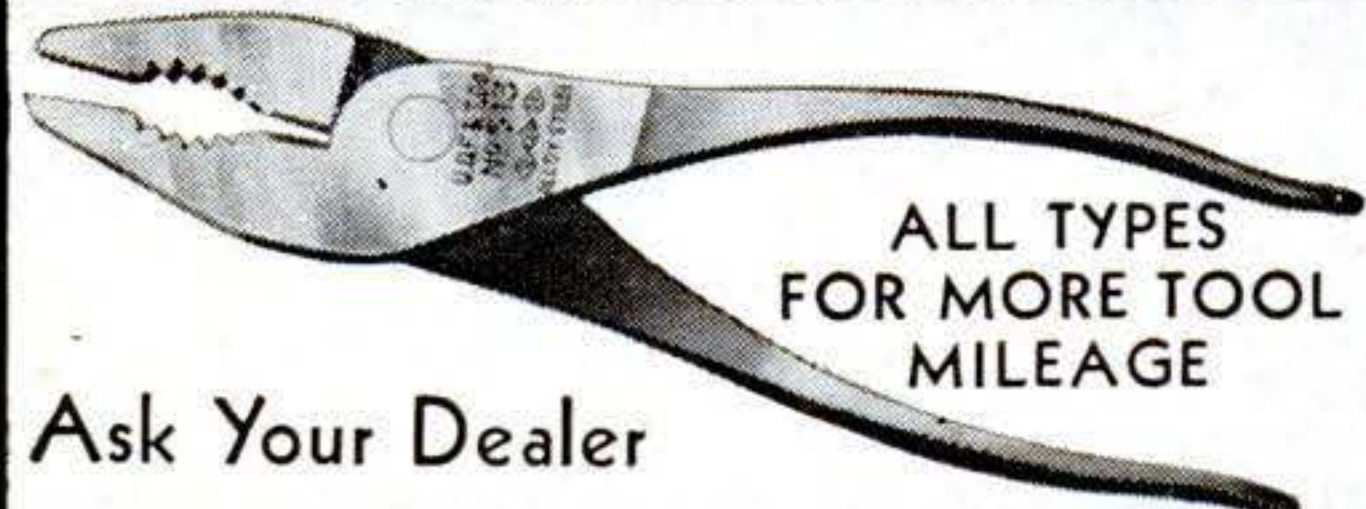
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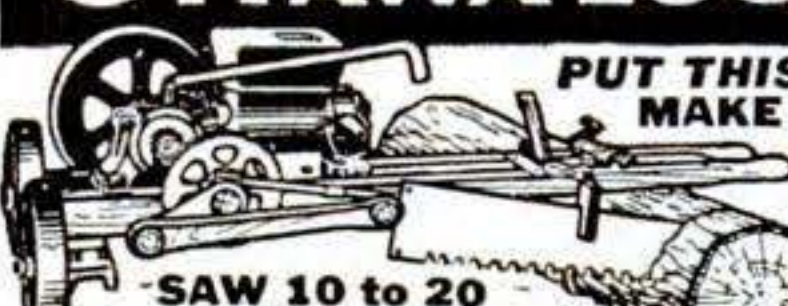
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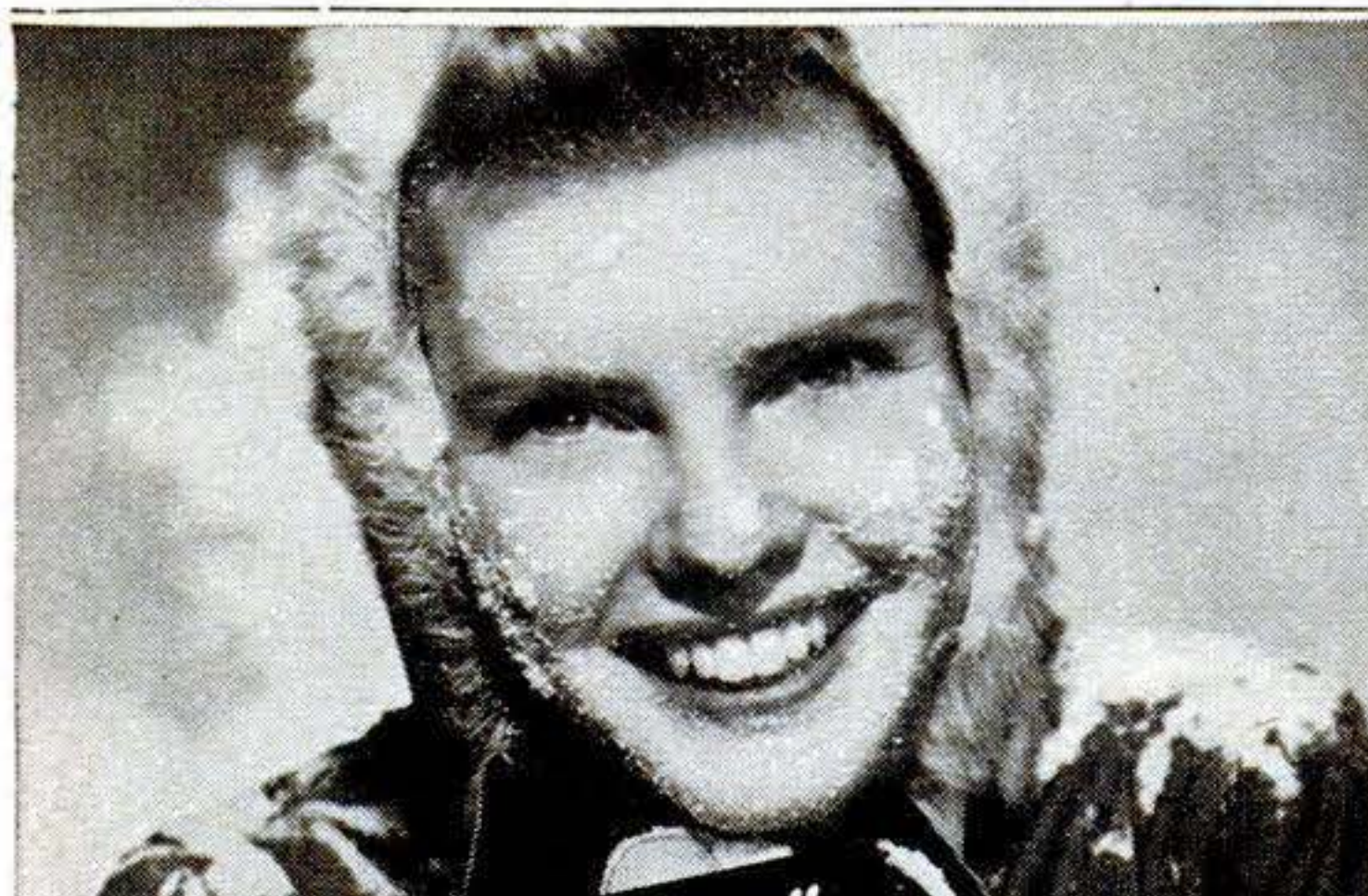
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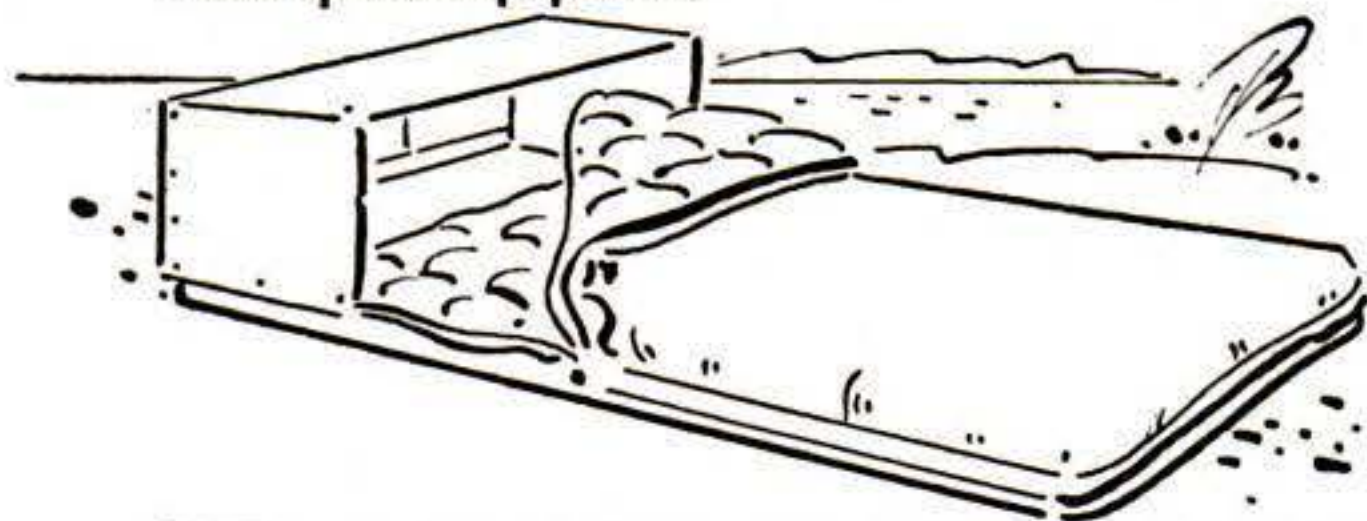


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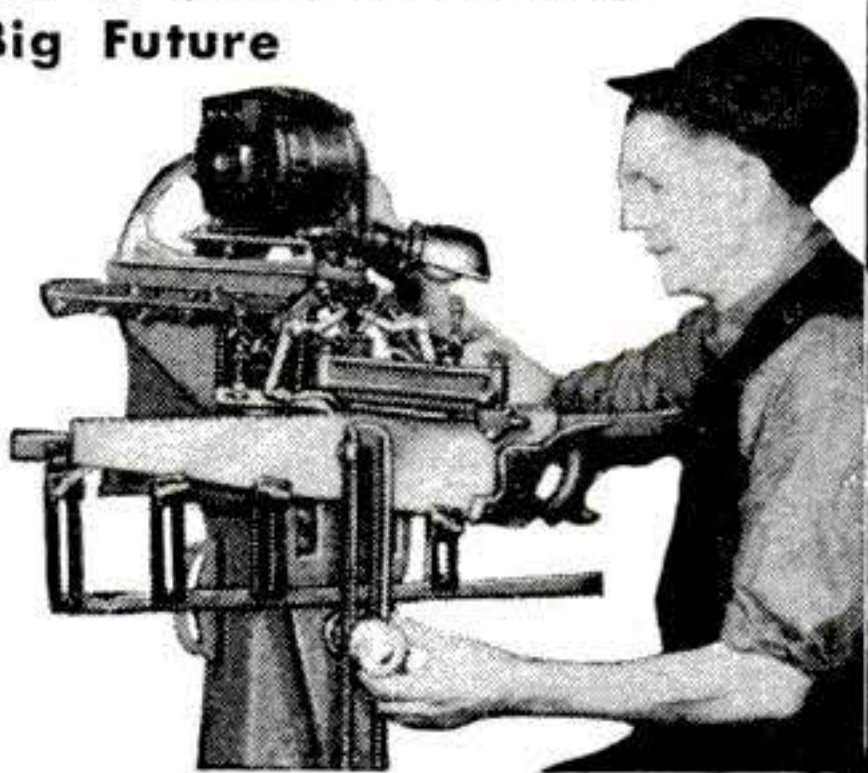
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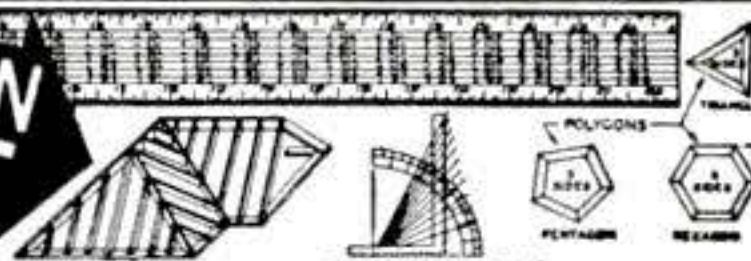
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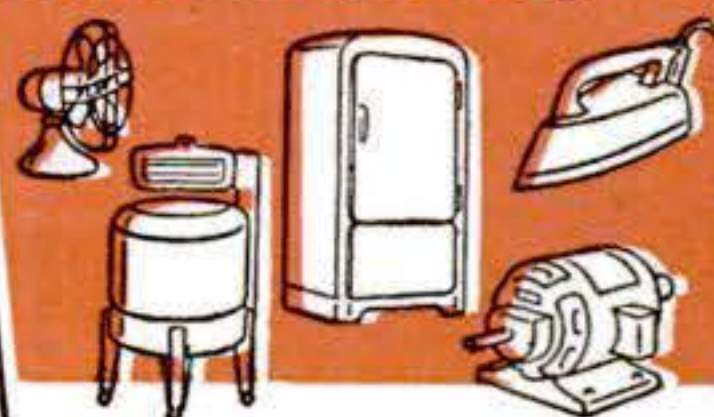
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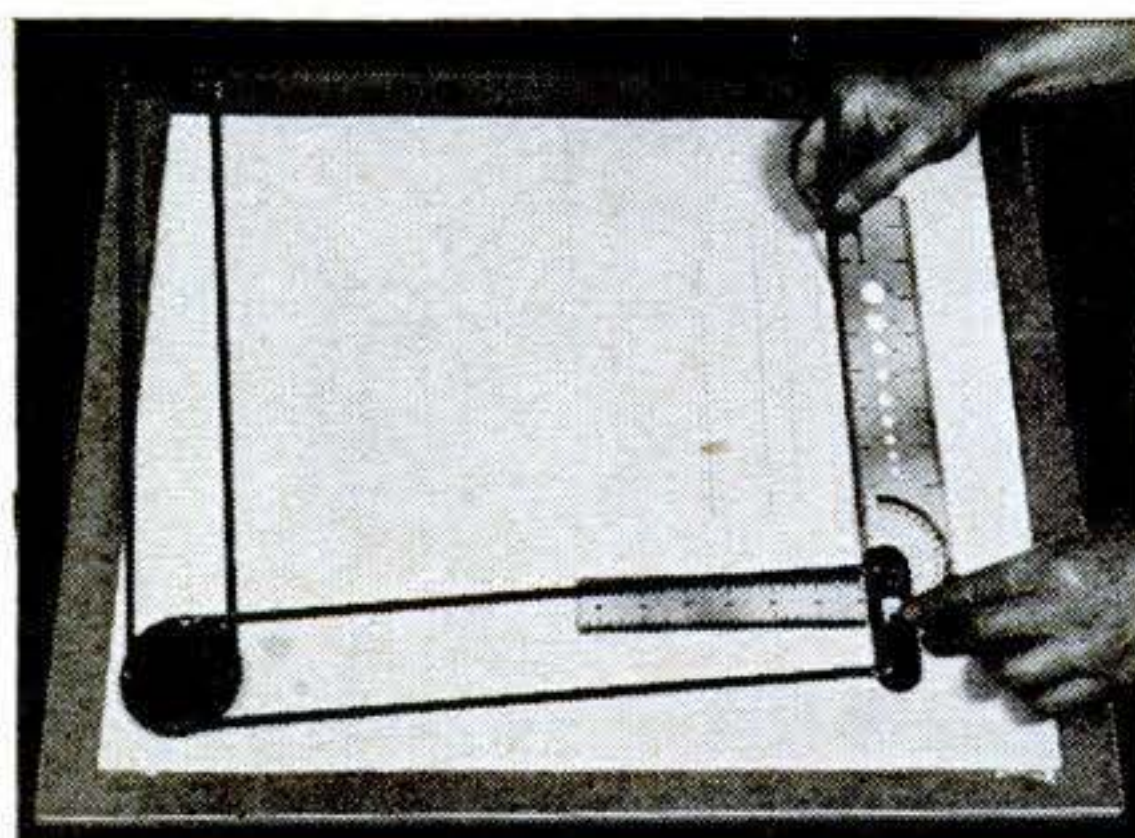
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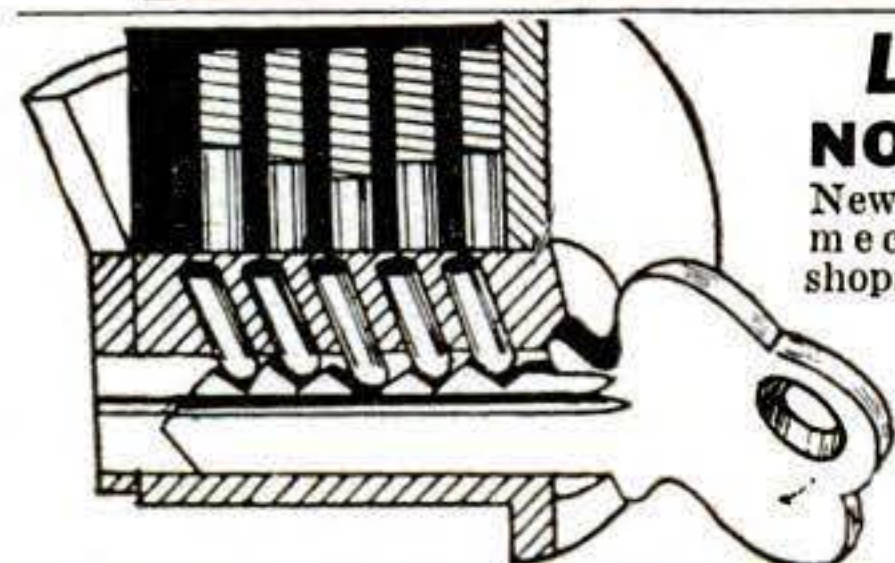


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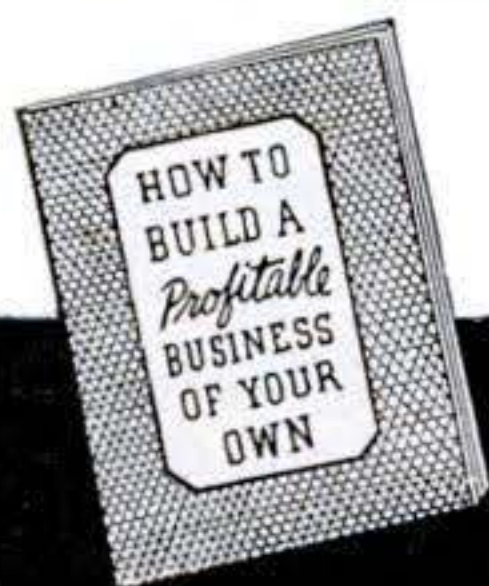
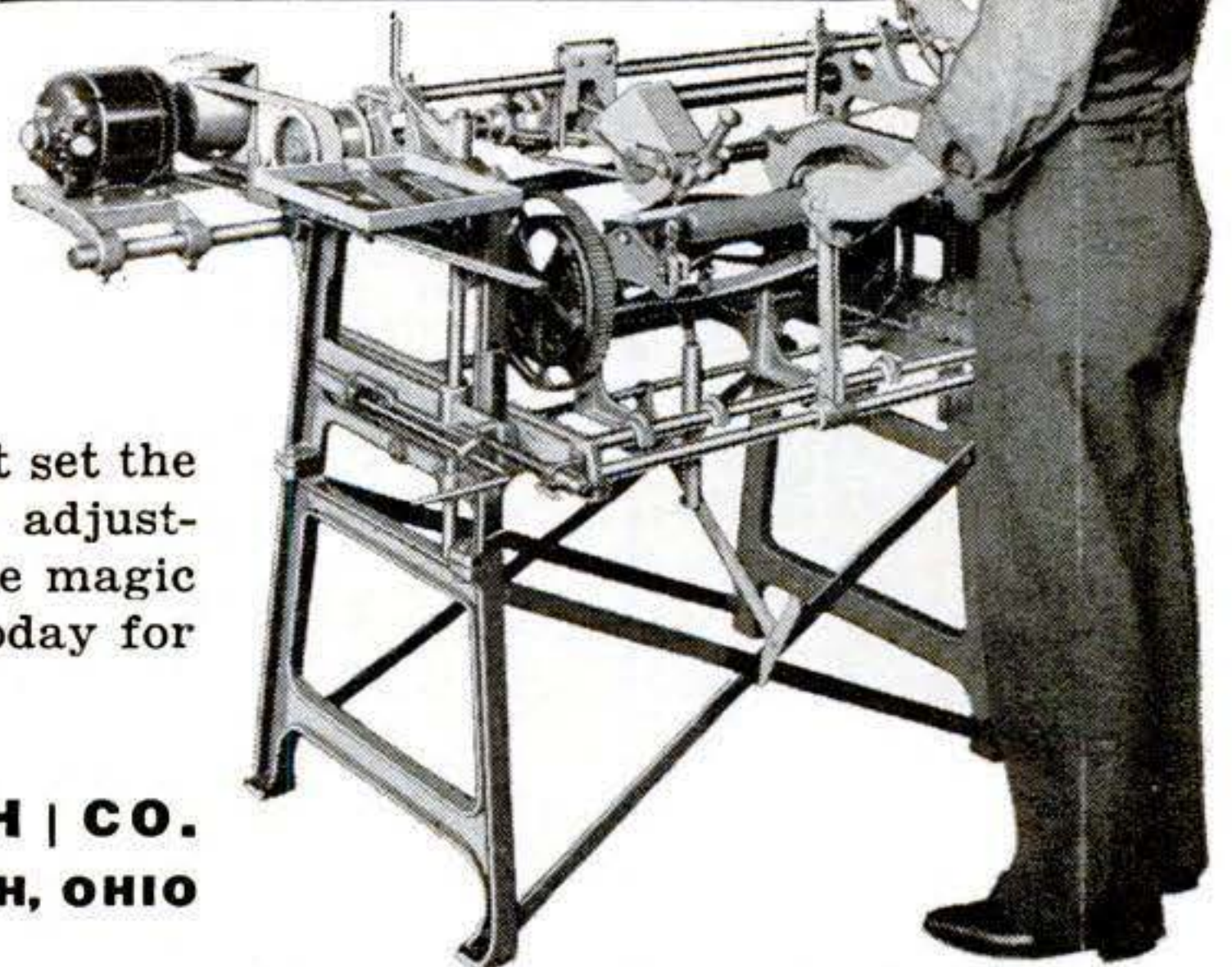
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The method was found in remote and mysterious Tibet, formerly a forbidden country, rarely visited by outsiders, and often called the land of miracles in the astounding books written about it. Here, behind the highest mountains in the world, Mr. Dingle learned the extraordinary system he is now disclosing to the Western world.

He maintains that all of us are giants in strength and mind-power, capable of surprising feats, from the delay of old age to the prolonging of youth, and the achievement of dazzling business and professional success.

From childhood, however, we are hypnotized, our powers put to sleep, by the suggestions of associates, by what we read, and by various experiences. To realize their really marvelous powers, men and women must escape from this hypnotism.



The method found by Mr. Dingle in Tibet is said to be remarkably instrumental in freeing the mind of the hypnotizing ideas that paralyze the giant powers within us.

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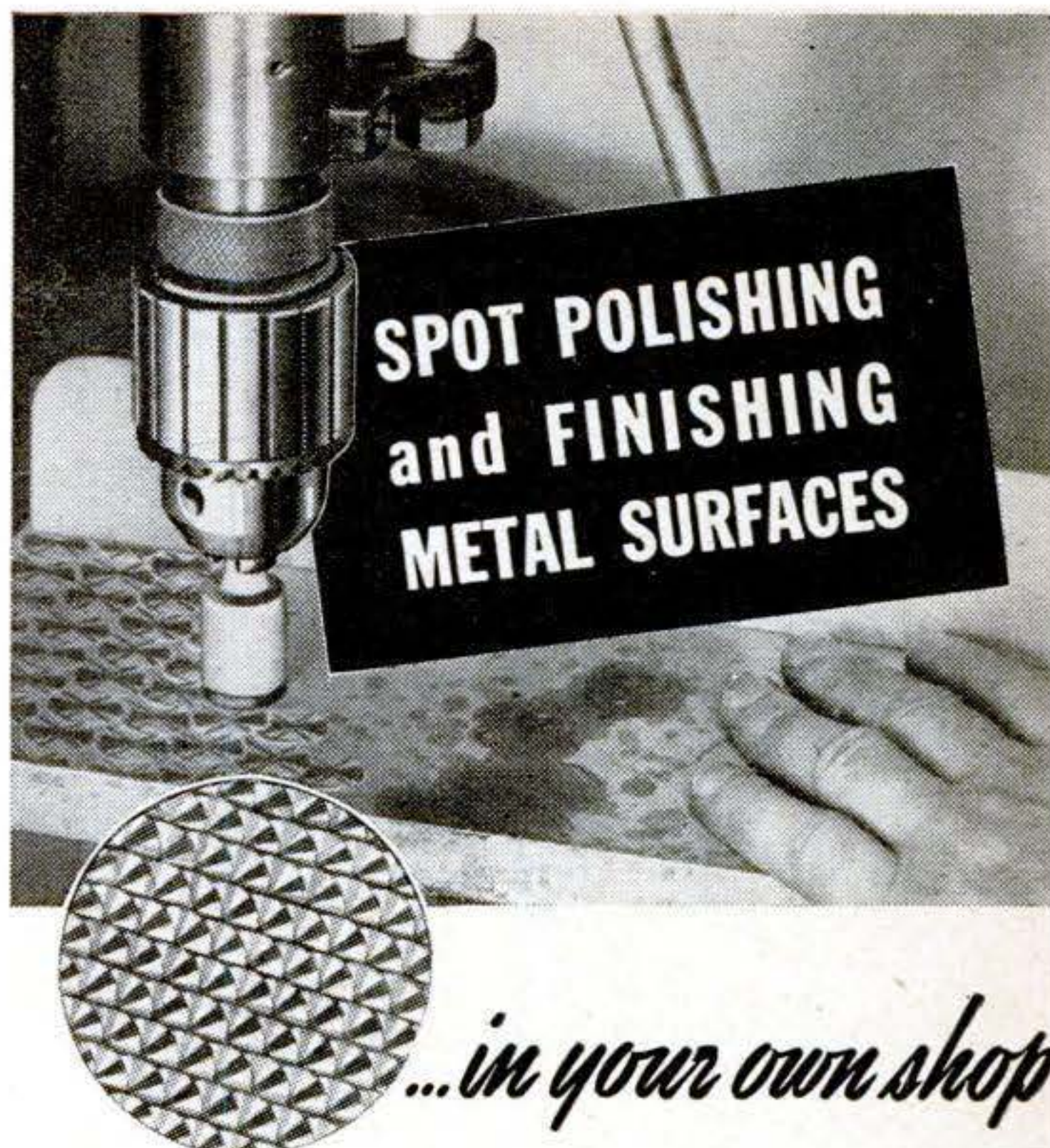
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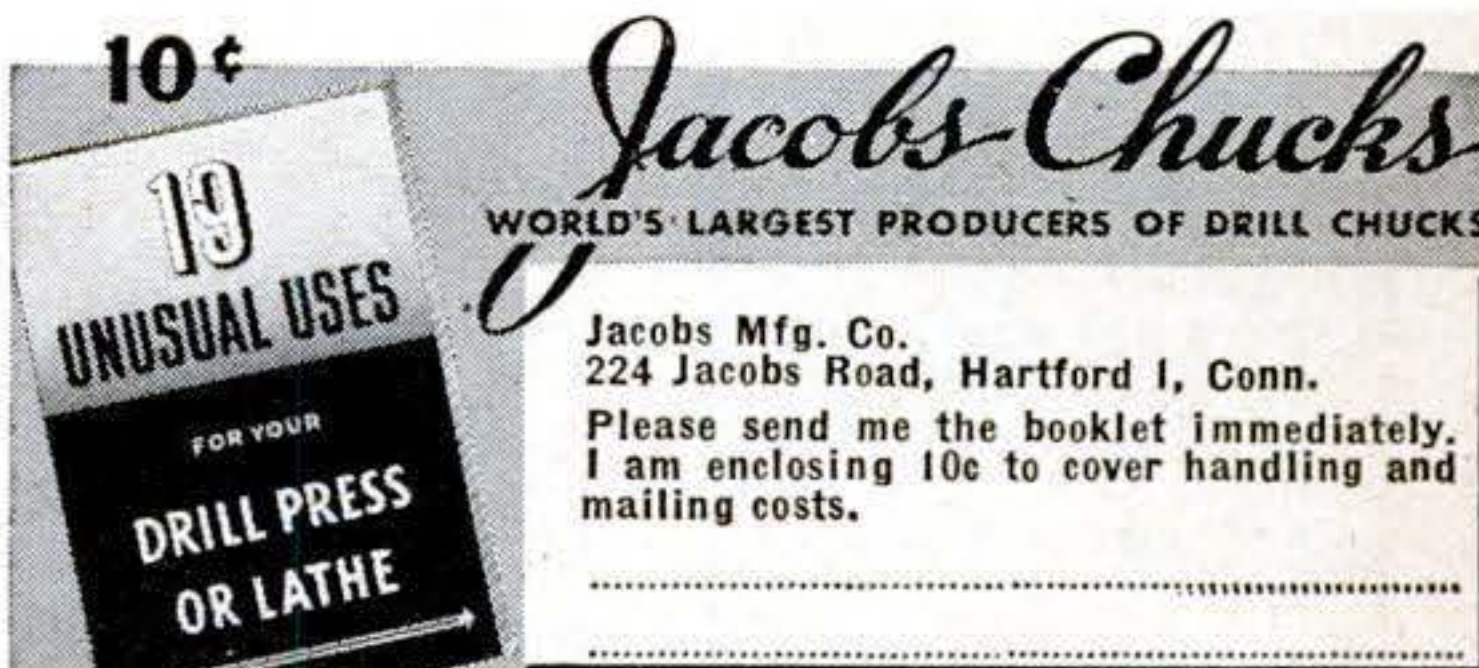


Surface coatings of rust or gummy film which accumulate on the machined tables and guides of jig saws, band and bench saws are quickly removed and a new precision-looking finish given to machined surfaces by "spot polishing".

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If this keeps up—we're all going to be in hot water.

The government's done a lot to keep prices down. That's what price ceilings and wage controls are for. Rationing helps, too.

But let me tell you this—we're *never* going to keep prices down unless we **ALL** help — **EVERY LAST ONE OF US**.

All right, then. Here are the seven rules we've got to follow as **GOSPEL** from now until this war is over. Not some of them — **ALL** of them. Not some of us — **ALL OF US**, farmers, businessmen, laborers, white collar workers!

Buy only what you need. A patch on your pants is a badge of honor these days.

Keep your OWN prices DOWN. Don't ask higher prices—for your own labor, your own services, or goods you sell. Resist all pressure to force **YOUR** prices up!

Never pay a penny more than the ceiling price for **ANYTHING**. Don't buy rationed goods without giving up the right amount of coupons.

Pay your taxes willingly, no matter how stiff they get. This war's got to be paid for and *taxes are the cheapest way to do it.*

Pay off your old debts. Don't make any new ones.

Start a savings account and make regular deposits. Buy and keep up life insurance.

Buy War Bonds and hold on to them. Buy them with dimes and dollars it **HURTS** like blazes to do without.

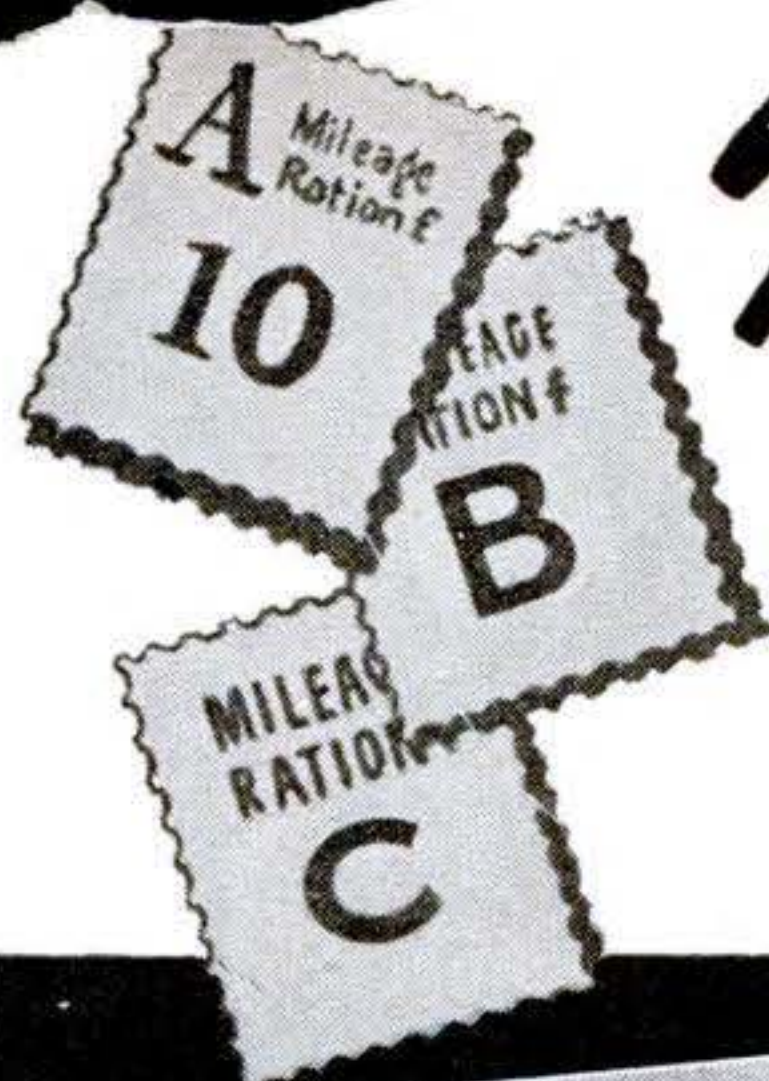
Start making these sacrifices now—keep them up for the duration—and this country of ours will be sitting pretty after the war . . . *and so will you.*

Uncle Sam

KEEP PRICES DOWN!

Use it up • Wear it out
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